BULLETIN 39

The Metal Resources of New Mexico and Their Economic Features Through 1954

A revision of Bulletin 7, by Lasky and Wootton, with detailed information for the years 1932-1954

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PURPOSE AND SCOPE OF BULLETIN

In this bulletin an attempt has been made to assemble information of particular value to those interested in developing and working the metalliferous deposits of New Mexico. Brief descriptions are given of all known deposits in the State other than those of iron and manganese. The history, production, and geology of the districts in which these deposits occur are treated in variable detail, depending upon the importance of the district. The bulletin also contains a conspectus of the metallic minerals found in New Mexico, together with a statement of their occurrence and distribution.

Uranium, which recently has become important in New Mexico, is treated in a separate section of this report.

Only brief consideration is devoted to the deposits and production of iron ore. This subject has been covered adequately by Dr. V. C. Kelley, of the University of New Mexico (1949). The discussion of manganese deposits and their production likewise is abbreviated, a separate report on this subject being in preparation by the New Mexico Bureau of Mines and Mineral Resources.

Some attention has been given to the economic features of the metals and minerals produced in the State. These features are subject, however, to rapid change resulting from fluctuations of supply and demand in the overall economy. The mining, milling, and smelting practices and costs which obtain today may become obsolete and disastrous a year from now.

Since the original publication of this bulletin in 1932, the metal-mining industry of New Mexico has undergone many changes. The peace- and wartime economies of the interval between 1932 and 1954 stimulated production from both old and new mines. New ore bodies were discovered, and new mines were brought into production. Some mines were depleted of ore and abandoned; even whole districts were mined out and became inactive.

The location and description of some old districts that were overlooked by Lasky and Wootton (1933) in their original report are included in this revision, not because of their past importance but because of their future possibilities in the light of new mining methods and improved milling techniques.

OTHER REPORTS DEALING WITH THE GEOLOGY AND MINERAL RESOURCES OF NEW MEXICO

The mineral resources of New Mexico have been described by several writers. An early volume entitled "New Mexico Mines and Minerals," by Fayette A. Jones, was published in 1904, but the first comprehensive

description of the ore deposits of the State was the report of Lindgren, Graton, and Gordon, "The Ore Deposits of New Mexico," issued in 1910. The report by James M. Hill, "Mining Districts of the Western United States," published in 1912, contains a section on New Mexico, including a map of the State showing the location of each mining district and noting its predominant metal. The map is accompanied by text information giving for each camp a full list of the metals produced, the shipping point for the camp, and a brief statement of the geologic formation and the kind of deposit. The New Mexico School of Mines published a short report by F. A. Jones entitled "The Mineral Resources of New Mexico," in 1915. In 1917 the U. S. Geological Survey published a bulletin entitled "Useful Minerals of the United States," which, among other features, gives concisely the location by states and counties of the principal deposits of useful minerals known at that time, thus affording a valuable supplement to Hill's report. A map of the State showing the location of all known mining districts, prepared by Stuart A. Northrop, was released by the University of New Mexico in 1942. Unfortunately all the foregoing publications are now out of print and not available to the general public except through public and semipublic libraries.

The annual volumes of "Mineral Resources of the United States," published until 1923 by the U. S. Geological Survey, and since then by the U. S. Bureau of Mines, consist mainly of statistics of production and market conditions, although also containing occasional geologic descriptions. In 1930 the University of New Mexico published a bulletin called "New Mexico Mineral Deposits Except Fuels," which covers briefly both metallic and nonmetallic deposits, except oil, gas, and coal.

The best general description of the geology of New Mexico is contained in two bulletins by N. H. Darton entitled " 'Red Beds' and Associated Formations in New Mexico; With an Outline of the Geology of the State" (1928), and "Geologic Structure of Parts of New Mexico" (1922). Darton's geologic map of New Mexico (scale 1:500,000), published by the U. S. Geological Survey in 1928, is invaluable to students of the geology of the State. This map is now out of print, but a revised edition is in preparation.

Older bibliographical summaries of the geologic literature of New Mexico by T. P. Wootton (1930) and Robert L. Bates and Marian R. Burks (1945) have been superseded by Marian R. Burks and John H. Schilling, "Bibliography of New Mexico Geology and Mineral Technology Through 1950," published by the New Mexico Bureau of Mines and Mineral Resources in 1955. The latter volume has been supplemented and brought up to date by Constance F. and John H. Schilling (1956), "Bibliography of New Mexico Geology and Mineral Technology, 1951-1956," published under the same auspices.

ACKNOWLEDGMENTS

Like its predecessor (Lasky and Wootton, 1933), this volume is chiefly a compilation. Unless otherwise noted, production statistics for the period prior to 1932 were compiled from the annual volumes of "Mineral Resources of the United States" and the "Minerals Yearbook." For a listing of other sources employed in preparing the previous edition, the reader is referred to the "acknowledgments" recorded in the earlier volume.

In the preparation of the present revision, current scientific and technical periodicals have been consulted freely, especially the bulletins on the geology and ore deposits of Sierra and Dona Ana Counties by Harley (1934) and Dunham (1935) respectively, and an unpublished report on the mineral resources of Colfax County by Pettit. Geologic summaries have been abstracted principally from publications of the U. S. Geological Survey and the New Mexico Bureau of Mines and Mineral Resources.

Production figures for the years 1932-1954 were derived from the "Minerals Yearbook" and from the annual reports of the State Inspector of Mines. For mines that are currently active, operational data were obtained from the files of the operating companies; in the case of mines which are no longer active, former personnel and old records were the sources of such information. We are especially grateful to the personnel of the U. S. Bureau of Mines at Silver City (office since removed to Tucson, Ariz.) for their courteous assistance.

Historical Review

The early history of mining in New Mexico has been described (Lindgren, Graton, and Gordon, 1910, p 17), as follows:

> Unlike the more northerly States, New Mexico was at the time of the discovery of America settled by tribes of semicivilized Pueblo Indians, who lived in well-constructed cities and who practiced agriculture by the aid of irrigation. Mining was not extensively developed among them, but they knew the value of turquoise, which occurs in various places in the Territory and which was used by them for ornaments and probably also in some way as money. There is also some evidence that they used gold for ornaments and that they probably obtained some of it from placers within the region. The first white man who set foot in the Territory is believed to have been Alvar Nunez Cabeza de Vaca, who reached it from the East in 1534. An expedition headed by Coronado explored the northern part of the Territory in 1540 and 1541. Between 1580 and 1680 the Indians were converted to Christianity by Spanish monks, and a number of missions were established.
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> The early Spanish explorers speak of turquoise as being obtained in the country, and it is now a generally accepted belief that the quarries containing turquoise in Cerrillos were worked prior to the advent of the Spaniards. There is also some evidence that the turquoise mines of the Burro Mountains and the Hachita Range were similarly worked at a very early date. The early missions were established principally by the Jesuits, and it is believed that some mining was done by the Indians under their direction. It is thought that gold was obtained from the gravels near Taos, and there is some evidence of early attempts to open silver mines. Traces of such ancient mining for silver are found in the Los Cerrillos district, as a prospect near Ojo Caliente, and possibly also in the Hachita Range. The evidence is, however, not conclusive.
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> In 1680 the Pueblo Indians revolted against the oppressive rule of the Jesuits, and the Spaniards were obliged to abandon the country, returning, however, about twenty years later. It is stated that on their return it was expressly stipulated by the Indians that the Spaniards should not again engage in mining, but only in agricultural pursuits. At any rate, little mining was done during the eighteenth century. F. A. Jones [1904, p 13] mentions a document found in Santa Fe under date of 1713, which refers to an old covered-up mine in the "Sierra de San Lazora." About the end of the eighteenth century the copper mines at Santa Rita, in the southwestern part of the Territory, were discovered, and they are said to have had a large production for a time. It is worthy of note that these mines have been almost continuously worked up to the present day.

The first systematic mining by white men in New Mexico was at the Santa Rita copper deposits. The Santa Rita mines were among the earliest of the underground copper mines in the United States. According to tradition, the Apaches mined and utilized the native copper of the Santa Rita deposits in the 17th century. In 1800 an Indian showed

the deposits to a Spanish officer in return for some kindness that had been rendered, and in 1801 shipments of copper were started to Chihuahua, Mexico, and to Mexico City. This production is said to have amounted to as much as 20,000 muleloads, or 4 million pounds, per annum, during the early part of the century. The mines passed through a number of hands and yielded a moderate production until the organization of the Chino Copper Co. in 1909. Steam-shovel mining was instituted by this company, and extensive production was begun in 1912. Since then the Chino mines have accounted consistently for the major part of New Mexico's copper production. The property was acquired in 1924 by the Ray Consolidated Copper Co. of Arizona, which in 1926 became a part of the Nevada Consolidated Copper Co. The Santa Rita copper mines are now known as the Chino Mines Division of the Kennecott Copper Corp.

Gold was discovered in New Mexico in 1828 at the Old Placers, in the Ortiz Mountains, south of Santa Fe, Santa Fe County. This is the first authentic record of placer mining in the United States west of the Mississippi River. Jones (1915, p 9) states that this discovery constituted the initial impulse toward development of the West. The discovery of the Old Placers was made 20 years before the first gold excitement in California and 30 years before the first discoveries in Colorado. Gold-quartz veins were discovered near the Old Placers in 1833, and in 1839 the rich New Placers in Santa Fe County were discovered.

Lead ore was found in the Organ Mountains in 1849. For several years a small production was maintained, but here, as elsewhere, operations were handicapped seriously by the hostility of the Indians. Gold placers were discovered at Pinos Altos, about 12 miles northwest of Santa Rita, Grant County, in 1859 or 1860, and vein deposits were discovered there a few months later. Prospectors soon were forced by the Indians to leave the area. Practically all mining work in the Territory was suspended during the Confederate invasion under General Sibley in 1861 and 1862. Mining was resumed in several districts in 1863, but in the Pinos Altos district this was delayed until 1867.

In 1863 a soldier by the name of Pete Kinsinger is said to have found rich silver ore while stationed at Pueblo Springs near Magdalena, Socorro County. This is recorded as the first silver discovery in the State. The lead-silver deposits of the Magdalena district were found 3 years later by J. S. Hutchason, while hunting for Kinsinger's discovery. A year later, in 1867, prospectors spreading out from Magdalena found silver veins in the Socorro Peak district. At about the same time placer gold was found in the Elizabethtown district, in Colfax County, by prospectors from Colorado.

The construction of the Southern Pacific and the Atchison, Topeka and Santa Fe railway lines through New Mexico was followed by a period of important mining activity. Lindgren, Graton, and Gordon (1910, p 18) describe this period as follows:

> The surveying and construction of the Southern Pacific Railroad and the Atchison, Topeka and Santa Fe Railway through the central and southern parts of the Territory, from 1879 to 1882, brought a large number of prospectors and miners. This was an epoch of great activity. Practically all the mining districts now [1910] worked were then discovered and developed. It was essentially an epoch of silver mining; copper and the other base metals were little sought for, and even gold was less considered than silver. A great number of mills and small smelters were erected; many of the latter were built at inconvenient places and operated on unsuitable ores without much metallurgical knowledge. Rich silver ores were discovered, milled, or smelted at Silver City and Georgetown: and it is reported that over $3,000,000 in silver was obtained in a short time at Chloride Flat, near Silver City. Stamp mills were built at Pinos Altos. Rich silver-lead ores were extracted from the Victorio district near Deming. Many new discoveries were made in the Mimbres Mountains, or Black Range, for many years haunted by hostile Indians. In 1877 placers and gold-quartz veins were found near Hillsboro, and during the few following years the Hermosa, Kingston, Apache, and Cuchillo Negro districts were prospected and a considerable amount of silver ores extracted.
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> In 1878 were found the phenomenally rich silver mines of Lake Valley, which in a few years yielded a total of 5,000,000 ounces of silver, but which were soon worked out. The Mogollon Mountains, in western Socorro [Catron] County, close to the Arizona line, contain one of the richest districts of the Territory, though one of the most difficult of access. This vicinity, now known as the Cooney district, was first prospected in 1875, but not until about twenty years later was much progress made in the mining and reduction of the rich gold and silver ores. Small lead smelters were built at Socorro, Los Cerrillos, Hachita, and a number of other places. The Socorro plant was built [in 1881], and in 1887 another lead smelter was erected at El Paso, Tex.

As noted above, deposits discovered in this period were mined chiefly for their silver content. Most of them consisted of oxidized ores near the surface, and these were soon exhausted. The gradual fall in the price of silver from $1.07 per ounce in 1885 to below 60 cents in the final years of the 19th century resulted in the closing of many of the mines.

The increased demand for the base metals which developed at the beginning of the present century injected new life into the mining industry, and ores of these metals began to be sought. The smelters at Socorro, N. Mex., and El Paso, Tex., were acquired by the American Smelting 8c Refining Co., which dismantled the Socorro plant and enlarged the one at El Paso to permit the handling of copper ores. The copper smelter at Douglas, Ariz., was built in 1902. These smelters provided a market for base-metal ores of the State and stimulated prospecting.

In 1903 high-grade zinc ores were discovered associated with the lead ores of the Magdalena district. This district was for many years the chief producer of zinc in the State. In 1905 production of zinc ore began in the Central and Pinos Altos districts, Grant County, and since then zinc has represented an important part of the State's metal output.

The Hanover district, Grant County, did not become an important producer of zinc until 1910, although zinc ore had been mined there since 1891 or earlier.

The low-grade copper deposits of the Burro Mountains district were discovered in 1900 and yielded moderate amounts of copper for several years. The Phelps Dodge Co., now the Phelps Dodge Corp., entered the district in 1905. Some years later a large tonnage of low-grade ore was developed by this company, and a concentrating mill with a capacity of 2,000 tons per day was constructed. An important production was maintained from 1916 to 1921, when the mines were closed. Considerable blocked-out ore remained in the ground. Recently (1941-1955) leaching operations have resulted once more in appreciable production.

The Lordsburg district, discovered in 1870, has been an important producer of copper since 1920, chiefly owing to the operations of the Calumet and Arizona Mining Co. at the Eighty-five mine. This mine was acquired by the Phelps Dodge Corp. in 1931.

In recent years base-metal ores have become an important source of gold and silver in New Mexico, but appreciable quantities of precious-metal ores have been sporadically produced at the Aztec mine of the Maxwell Land Grant Co., in the Elizabethtown district, Colfax County, and in the Mogollon district, Catron County, where the Mogollon Mines Co., now defunct, was the chief company. Large-scale operations in the Mogollon district were suspended in 1925, but the mine was reopened in 1931. Substantial production was attained until 1943, when operations again were discontinued.

The Pecos mine at Tererro, San Miguel County, was discovered in 1883. It was acquired in 1925 by the American Metal Co. of New Mexico, a subsidiary of the American Metal Co., Ltd. A modern concentrating mill was constructed, and large-scale operations began in 1926. In 1927 this mine became, and continued to be, the largest individual producer of zinc, lead, gold, and silver in New Mexico. It continued as such until 1939, when it was closed down.

In 1928 a large body of complex ore was discovered at the Ground Hog mine in the Central area, Grant County. This mine has yielded important amounts of zinc, lead, copper, and silver. A controlling interest in the mine was acquired in 1928 by the Asarco Mining Co., a subsidiary of the American Smelting & Refining Co. Other mines that have become important producers in the Central area since 1930 are the Bullfrog and Slate, Combination and Hobo, Kearney, Pewabic, Shingle Canyon, and Princess, all of which have been important producers of lead and zinc.

The iron mines at Fierro, Grant County, had their first recorded production in 1891. They were worked almost continuously from 1899 to 1931, except in 1904 and a part of 1907-1908, when operations were suspended on account of labor difficulties. The Hanover Bessemer Iron & Copper Co., which is controlled by the U. S. Smelting Refining &

Mining Co., is the chief producer. During World War II these deposits again were mined. There was also some production of iron ore from Lincoln and Socorro Counties during this period. All shipments went to the Colorado Fuel and Iron Co., at Pueblo, Colorado. At the end of World War II all production was discontinued for a time. Deposits at Boston Hill, near Silver City, Grant County, have yielded manganiferous iron ore since the nineties; during recent years some 70,000 tons per year have been shipped to iron furnaces at Pueblo, Colorado.

Numerous manganese deposits were worked during World War I, but only a moderate amount of ore was produced, and none of the properties which were active at that time has developed into a large mine. A large manganese deposit has been developed in the last few years in the Little Florida Mountains, Luna County; from it has come a major part of the better grade manganese ore mined in New Mexico. During World War II many of the manganese deposits of the State were worked again, but only small production was attained. All operations, with the exception of one just south of Socorro, were discontinued at the end of the war, but with the revival of the Government's stockpiling program, many properties have been reactivated.

The molybdenum deposits of the Red River district, Taos County, were recognized in 1917. The deposits were worked for a brief period by the R. & S. Molybdenum Co. and were acquired in 1920 by the Molybdenum Corporation of America. A concentrating mill was built, and the property became the second largest producer of molybdenum in the United States, a position it held until the copper companies began recovering molybdenum as a byproduct from low-grade copper ores. The mine continues active, but known ore reserves are not large.

Metal mining in the State was stimulated greatly by World War I. The industry was very prosperous from 1916 to 1918, but the depression of 1921 closed most of the mines, and production for that year was the lowest it had been since 1912. Rapid recovery was evident in 1922 and 1923, and there was a steady expansion in the industry until 1929, when the depression of the thirties began. Most of the metal mines of the State were closed by 1932. With the exception of the American Metal Company's Pecos mine, such operations as were continued were on a very reduced production schedule. The attention of miners turned to gold; many of the old producing districts, both placer and lode, were reexamined, and activities resumed in many of them.

Recovery from the depression began in the industry toward the close of the thirties. Evidence of the approaching new world conflict acted as a stimulant. With the beginning of hostilities in Europe in 1939, many mines had reopened or were preparing to do so, so that by the time the United States entered the conflict in December 1941, nearly all the metal mines of the State were active. During the period from 1942 to 1945 there occurred the greatest expansion in the mining industry New Mexico had ever experienced. The State contributed much to the war effort

of those years. Economic conditions for several years following the ending of hostilities were such that the mines of the State continued at maximum production. Between 1949 and early 1950 mining activities declined, but increased world tension and the beginning of hostilities in Korea in mid-1950 brought about the rapid revival of the industry. By the beginning of 1951 most mines were again producing at capacity, and old properties that had been idle for many years were being reexamined for possible production.

Metal Resources of New Mexico

SUMMARY OF GEOLOGY AND ORE DEPOSITS

A short, graphic description of the geology and ore deposits of New Mexico by Waldemar Lindgren appeared in a report by J. M. Hill (1912, pp 33-35). This description is given below, supplemented by a number of revisions and additions, in brackets [ ], chiefly by S. G. Lasky:

> The ore deposits of New Mexico form a gradually widening belt extending through the central portion of the State from Colfax County, at the north, to the southwest corner; in this southern part the districts are scattered over a wide area between El Paso and Silver City. . . . Gold, silver, copper, lead, and zinc are the principal metals of the output, and Grant, [San Miguel, Socorro, and Hidalgo] are the principal productive counties.
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> New Mexico contains several well-defined geologic provinces. Over the smaller eastern portion extend high plains or plateaus of horizontal or gently dipping Tertiary, Cretaceous, [Triassic,] and Carboniferous sediments. About the middle of the State these almost connect with the similar strata of the plateau province which cover the northwestern part, their monotony being broken only by several minor uplifts like the Zuñi Mountains.
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> Through the center of the State and trending north and south are a succession of ranges. Toward the Colorado boundary they are high and assume the type of the Rocky Mountain uplifts, with a central core of pre-Cambrian rocks surrounded by the upturned edges of Paleozoic and Mesozoic strata. Toward the south they are lower and are of the monoclinal type of the Basin Ranges, being limited on the east or west side by prominent faults. The pre-Cambrian is less prominently exposed and the sediments comprise a thick series. In the central [and southern] parts of the State a thin bed of Cambrian quartzite is covered by [several] hundred feet of Ordovician [limestone], 200 feet of Devonian shale, [up to 200] feet of Mississippian, [from 900 to 2,000] feet of Pennsylvanian limestone and [shale], and [by Permian "Red Beds" and limestone which reach a thickness of over a mile in eastern New Mexico]. Above this lies a small thickness of [Triassic and locally Jurassic] strata, and these are in turn covered by [remnants] of Cretaceous coal-bearing sandstones and shales [up to 2,000 feet thick]. [Triassic, Cretaceous, and Tertiary rocks are the surface rocks of most of the northeastern part of the State.] The southwest corner of New Mexico is occupied by a number of low ranges of the Arizona type, trending north-northwest, separated by wide desert plains and built up of folded and faulted Paleozoic and Mesozoic sediments [and Tertiary rocks]; these ranges rarely have pronounced monoclinal structure. Lavas of late Tertiary age, chiefly andesitic and rhyolitic, cover a large space in the southwest, separating the province of the desert ranges from the plateau province. These lavas also extend toward the northeast and occupy large areas north of Santa Fe, but are here mainly basalts of . . . Quaternary age. Minor intrusions of quartz monzonites [generally] of late

Cretaceous or early Tertiary age are known in nearly all the ranges and follow closely in their distribution the trend of the main mineral-bearing districts. [Some of these intrusions are later than a part of the lavas.]

Deposits of pre-Cambrian age are known to occur in the northern ranges in Colfax, Taos, and Rio Arriba counties. [Zinc], copper, and gold are the principal metals. The deposits form either lenticular quartz veins or disseminations [and fillings] of sulphides in [sheared] basic igneous rocks. At the Hamilton mine [now the Pecos mine of the American Metal Co. of New Mexico], in the Pecos district, Carboniferous strata cover the decomposed outcrops of a [zinc] deposit of the latter kind. Many of the deposits contain minerals like garnet, tourmaline, and amphibole. The principal [localities are the Pecos district in San Miguel County] and the Hopewell and Bromide districts, in Rio Arriba County, where veins of this kind . . . have been mined.

In New Mexico, as elsewhere in the Western States, the most abundant deposits are those which were formed at the end of the Cretaceous or in the earliest Tertiary and which stand in close connection with granite or monzonite intrusions, surrounding them like metallic aureoles. There are several subdivisions of this genetic class which yield ores of gold, silver, copper, lead, and zinc.

Contact-metamorphic deposits in the silicate zone between limestone and intrusive rocks are more abundant than in any of the other States except possibly Arizona. They carry copper ores in the Elizabethtown, San Pedro, Organ, Jarilla, Hanover, [Magdalena], and Hachita districts; lead and zinc ores are developed in the Magdalena and Tres Hermanas districts; iron ores at Hanover, Jones Camp, and other places. [At least fourteen] districts with such ores are known. Magdalena, San Pedro, and Hanover have yielded a considerable production of base metals.

Quartz veins almost invariably accompany the intrusions and are chiefly of the gold-bearing pyritic type, though in places they also carry silver, lead, and copper. The principal producing districts of this kind are Elizabethtown, Ortiz, White Oaks, and Pinos Altos. The silver veins form a smaller group, most of them occurring in Grant County. Replacement deposits of argentiferous galena or silver ores are found at some little distance from the intrusive contact and have been mined in the Organ, Hermosa, Kingston, Hillsboro, Lake Valley, Georgetown, Victorio, Chloride Flat, and Granite Gap districts. [Copper-tourmaline deposits occur in the Lordsburg district.]

In connection with this general type of mineralization near intrusive bodies, there are at a few places, such as the Burro Mountains and Santa Rita in Grant County, disseminations of cupriferous pyrite which are too poor to mine in themselves, but which have been enriched by a Recent or late Tertiary deposition of chalcocite formed by descending waters. These deposits now form large bodies of low-grade copper ore which are the main source of the copper production of the State.

Placer deposits, [some of] which formerly were highly productive, are worked [sporadically] at Elizabethtown, in Colfax County, in the Ortiz and San Pedro Mountains, at Hillsboro, at Pinos Altos, [in the Jicarilla Mountains, Lincoln County, and at Orogrande, in Otero County]. Most of them are derived from veins of early Tertiary age.

A distinctly later mineralization than that described above developed in some places in the lavas of middle or late Tertiary age, shortly after their eruption. It produced quartz veins carrying chiefly gold and silver and with certain characteristics indicating deposits near the surface. The principal districts are at Cochiti, in Sandoval County; at Hillsboro and in the Black Range, in Sierra County; and in the Mogollon district, in [Catron] County. ... .

Concentrations of chalcocite in the sandstones of the "Red Beds" of Triassic or late Carboniferous age are found at Tecolote and other places in San Miguel County; in the Nacimiento and Zuni Mountains, in the northwestern part of the state; at Estey, in Lincoln County; at Tularosa, in Otero County; [near Scholle, in Valencia County; at Pastura, in Guadalupe County;] and at several other places. [Lead mineralization also occurs in the "Red Beds."][1] The origin of these copper ores is still under discussion. . . . The deposits are in general independent of igneous rocks.

The iron ores consist chiefly of magnetite, occurring in contact-metamorphic deposits. They have been mined at Fierro [and near Santa Rita], in Grant County. A bed of limonite in Cretaceous strata has also been mined near Glorieta, in Santa Fe County, [and manganiferous iron ore has been mined at Boston Hill, in Grant County].

Bismuth ores occur in the San Andr[es] Range. Vanadium ores occur near Hillsboro and in the Caballo Range; [at Vanadium, Grant County; and near Magdalena, Socorro County].

The following paragraphs will serve to supplement and bring this description up to date:

Tungsten minerals occur at a number of places, notably the Victorio district of Luna County; the White Oaks district, Lincoln County; the Apache No. 2 district, Hidalgo County; and the Iron Mountain district of Sierra County. Molybdenum ore has been mined since 1920 in the Red River district of Taos County, and is recovered as a byproduct from the copper ores at Santa Rita, Grant County; other occurrences of lesser importance also have been reported. Cobalt and nickel occur in silver ore in the Black Hawk district, Grant County. Lode and placer deposits of tin have been found associated with rhyolite in the Taylor Creek district, in Catron and Sierra Counties.

Several kinds of manganese oxide ores have been mined, chiefly in Grant, Luna, Sierra, and Socorro Counties. Several newly discovered manganese deposits were opened up and produced during World War II. Antimony and arsenic occur chiefly as subordinate constituents of other ores. Stibnite has been mined in the Hachita district, Grant County.

Ore containing radium and uranium has been mined in the White Signal district, Grant County. Uranium ores are presently being mined in the Shiprock area of San Juan County and in the Mount Taylor district of McKinley and Valencia Counties. Some vanadium is recovered from the uranium ores.

1. Lasky (1932, pp 133-137).

Beryllium ores currently are being mined at the Harding mine in Taos County. This mine also produces lithium and tantalum ores. Similar ores are also present in the Rociada and Ribera districts, San Miguel County. The Petaca district, Rio Arriba County, produces columbite-tantalite ores and some beryl. Bismuth also is found in some of the pegmatites of this district. Monazite and bastnaesite ores of rare earth elements are produced in Lincoln and San Miguel Counties.

OCCURRENCE AND DISTRIBUTION OF NEW MEXICO ORE MINERALS

The known ore minerals of New Mexico are listed on the following pages, alphabetically arranged under the different metals. The mineralogic and common names, chemical composition, and geographic distribution by counties and districts are noted.

The chemical symbols of the metals and other elements which unite in different combinations to form the ore minerals are as follows:

Element	Symbol	Element	Symbol
Aluminum	Al	Manganese	Mn
Antimony	Sb	Molybdenum	Mo
Arsenic	As	Nickel	Ni
Barium	Ba	Niobium	Nb
Beryllium	Be	Nitrogen	N
Bismuth	Bi	Oxygen	O
Bromine	Br	Phosphorus	P
Cadmium	Cd	Potassium	K
Calcium	Ca	Silicon	Si
Carbon	C	Silver	Ag
Chlorine	Cl	Sulfur	S
Cobalt	Co	Tantalum	Ta
Columbium	Cb	Tellurium	Te
Copper	Cu	Thorium	Th
Gold	Au	Tin	Sn
Hydrogen	H	Titanium	Ti
Iodine	I	Tungsten	W
Iron	Fe	Uranium	U
Lead	Pb	Vanadium	V
Lithium	Li	Zinc	Zn

RARE EARTHS

Cerium	Scandium
Erbium	Selenium
Gallium	Tanthanum
Germanium	Thallium
Indium	Yttrium
Rubidium	and others

ANTIMONY

Antimony minerals are known in New Mexico chiefly as accessory constituents of other ores. Antimony is an undesirable constituent of a smelting ore and should be removed by milling, if possible, before the ore is shipped.

Bournonite. See under copper minerals.

Cervantite. Antimony trioxide and pentoxide ($Sb_2O_3 \cdot Sb_2O_5$). Grant County: Central district.

Polybasite. See under silver minerals.

Stibnite (antimony glance). Antimony trisulfide (Sb_2S_3). Grant County: Hachita district, with silver ores; reported near Santa Rita. Santa Fe County: Cerrillos district. Taos County: Twining district (?).

Stephanite. See under silver minerals.

Tetrahedrite. See under copper minerals.

ARSENIC

The general remarks concerning the occurrence of antimony apply also to arsenic. It is produced chiefly by copper smelters as a byproduct from arsenical copper ores.

Annabergite. See under nickel minerals.

Arsenopyrite (mispickel). Sulfarsenide of iron (FeAsS). Hidalgo County: Lordsburg district, reported. San Miguel County: Dalton Canyon and La Posada areas. Santa Fe County: Old Placers district, reported.

Chloanthite-smaltite. See under nickel minerals.

Domeykite. See under copper minerals.

Enargite. See under copper minerals.

Erythrite. See under cobalt minerals.

Mimetite. See under lead minerals.

Niccolite. See under nickel minerals.

Pearceite. See under silver minerals.

Proustite. See under silver minerals.

Stromeyerite. See under silver minerals.

Tennantite. See under copper minerals.

Xanthoconite. See under silver minerals.

Arsenic occurs in the lead-silver ores of the Victorio district, Luna County; in the Hachita district, Grant County; in the San Simon district, Hidalgo County; and in the copper-silver ores of the Jicarilla district, Lincoln County; but its mineral combination at these places is unknown. Copper arsenates of undetermined composition occur in the Hansonburg district, Socorro County.

BERYLLIUM

Beryllium. The ores of beryllium, chiefly beryl ($Be_3Al_2SiO_6O_{18}$) and helvite [$3Be(Mn{\bullet}FeZn_7)SiO_4$ + (Mn • Fe • Zn)S], occur in the pegmatites of Rio Arriba, Taos, San Miguel, and Santa Fe Counties and in the Iron Mountain district of Socorro County. The only commercial production so far has come from the

Harding mine, of the Picuris district, Taos County, and the Old Priest mine, in San Miguel County.

BISMUTH

Bismuth (native). An element (Bi). Dona Ana County: Organ district, at places in commercial quantities, associated with other ores. Grant County: Big Burro Mountains, reported. Luna County: Fremont district, rare with silver ores. Sierra County: Grandview district, rare, with bismuth ores.

Bismuthinite (bismuth glance). Bismuth sulfide (Bi_2S_3). Dona Ana County: Organ district, associated with copper-silver ores in workable quantities; Gold Camp district, in quartz-pyrite veins. San Miguel County: El Porvenir district, with molybdenum and tungsten minerals. Sierra County: Grandview Canyon district, San Andres Mountains, mined with other bismuth minerals and scheelite. Rio Arriba County: Petaca district.

Bismutite. Basic bismuth carbonate ($Bi_2O_3 \cdot CO_2 \cdot H_2O$). Sierra County: Grandview district. Grant County: Big Burro Mountains. Probably accompanies every occurrence of bismuth minerals, of which it is an oxidation product.

Tetradymite. Bismuth telluride (Bi_2Te_3). Colfax County: Baldy district, with gold ores. Hidalgo County: Sylvanite district, with free gold. Sierra County: Hillsboro district, rare.

Bismuth has been recovered from ores of the Apache No. 2 district, Hidalgo County, but the mineralogy is not known.

CADMIUM

The usual occurrence of cadmium is in greenockite associated with certain minerals in zinc deposits.

Greenockite. Cadmium sulfide (CdS). Grant County: reported from Hanover and Pinos Altos districts. Socorro County: Magdalena district, in very minor quantity with smithsonite.

COBALT

Chloanthite-smaltite. See under nickel minerals.

Erythrite (cobalt bloom). Hydrous cobalt arsenate ($Co_3As_2O_8 \cdot 8H2O$). Grant County: Black Hawk district, with silver ores.

COLUMBIUM

The columbium-bearing minerals recognized as being of importance are the columbite-tantalite ores [$(FeMn)(CbTa)_2O_6$] occurring in many of the pegmatites of the northern part of the State, especially in the Petaca district, Rio Arriba County.

COPPER

Copper minerals occur, at least in traces, in nearly every district in New Mexico.

Aurichalcite. A basic carbonate of zinc and copper [$2(Zn,Cu)CO_3 \cdot 3(Zn,Cu)(OH)_2$]. An unusual mineral. Socorro County: Magdalena district.

Azurite. Basic copper carbonate [$2CuCO_3 \cdot Cu(OH)_2$]. Occurs in most districts in which copper minerals are present. Generally in very small amounts, except in deposits in "Red Beds," in which it is one of the principal minerals. Catron County: Mogollon district, with silver ores. Dona Ana County: Hembrillo district. Eddy County (?). Grant County: Burro Mountains and Central districts; Pinos Altos district with lead-silver-zinc ores; Santa Rita district. Guadalupe County: Pastura district, important. Hidalgo County: Apache No. 2 and Fremont districts; Hachita district, with lead-silver ores; Lordsburg and San Simon districts. Lincoln County: Estey district, important; Jicarilla district, with gold ores. Mora County: Coyote district. Otero County: Tularosa and Sacramento districts, important. Rio Arriba County: Abiquiu, Bromide, and Gallina districts. Sandoval County: Nacimiento district, important; Placitas district. San Miguel County: Rociada district; Tecolote district, important. Santa Fe County: Glorieta district, important; La Bajada district. Sierra County: Caballos Mountains, Chloride, Hillsboro, and Salinas Peak districts. Socorro County: Hansonburg district, with lead ores; Ladron Mountains, Magdalena, Mockingbird Gap, and Water Canyon districts; Chupadero, Rayo, and Scholle districts, important. Taos County: Red River and Twining districts. Valencia County: Zuni Mountains district.

Bornite (peacock ore, purple copper ore). Copper-iron sulfide (Cu_5FeS_4). Catron County: Mogollon district, with silver ores. Grant County: Santa Rita district. Hidalgo County: Lordsburg and San Simon districts. Guadalupe County: Pastura district. Lincoln County: Estey district. Otero County: Sacramento district. Rio Arriba County: Gallina district. Sandoval County: Nacimiento district. San Miguel County: Rociada, Tecolote, and Willow Creek districts. Sierra County: Caballos Mountains and Chloride districts; Goodfortune Creek district, rare; Hermosa and Hillsboro districts, with silver ores. Socorro County: Joyita Hills district, rare; Magdalena and Scholle districts. Taos County: Twining district.

Bournonite (wheel ore, cogwheel ore). Copper-lead sulfantimonite [$3(Pb,Cu_2)S \cdot Sb_2S_3$]. Grant County: Central district. Santa Fe County: Cerrillos district.

Brochantite. A basic sulfate of copper [$CuSO_4 \cdot 3Cu(OH)_2$]. Dona Ana County: Organ district. Socorro County: Magdalena district (?).

Chalcanthite (blue vitriol). Hydrous copper sulfate ($CuSO_4 \cdot 5H_2O$). San Miguel County: Willow Creek district. Socorro County: Magdalena district.

Chalcocite (copper glance). Copper sulfide (Cu_2S). Catron County: Mogollon district, with silver ores. Dona Ana County: Hembrillo district, principal ore mineral; Organ district. Eddy County (?). Grant County: Burro Mountains district, principal ore mineral; Hanover-Fierro district, with iron and zinc ores; Santa Rita district, very important. Guadalupe County: Pastura district. Hidalgo County: Apache No. 2 and Hachita districts. Lincoln County: Estey district; Jicarilla district, with gold ores. Mora County: Coyote district. Otero County: Orogrande district; Tularosa and Sacramento districts, important. Rio Arriba County: Abiquiu district. Sandoval County: Nacimiento district, principal ore mineral. San Miguel County: Rociada and Willow Creek districts; Tecolote district, important. Santa Fe County: Glorieta and La Bajada

districts. Sierra County: Caballos Mountains, Chloride, and Hillsboro districts; Goodfortune Creek district, principal ore mineral. Socorro County: Hansonburg district; Jones Camp, with iron ore; Joyita Hills and Ladron Mountains districts, small; Magdalena, Mill Canyon, Mockingbird Gap, and North Magdalena districts; Rayo district, chief ore mineral; Scholle district, important; Water Canyon district, rare. Taos County: Picuris district. Valencia County: Zuni Mountains.

Chalcopyrite (copper pyrites, yellow copper ore). Copper-iron sulfide ($CuFeS_2$). Catron County: Mogollon district, with silver ores. Colfax County: Cimarroncito, Elizabethtown, and Baldy districts, with gold ores. Dona Ana County: Gold Camp, in gold veins; Organ district, with copper deposits only. Grant County: Burro Mountains and Central districts; Hanover-Fierro district, with iron ores; Hachita district, rare; Pinos Altos and Santa Rita districts; Steeple Rock district, in gold-silver veins; White Signal district, in gold veins. Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, and San Simon districts; Steins Pass district, with silver ores. Lincoln County: Estey district, in "Red Beds"; Nogal district, with gold ores. Luna County: Florida Mountains district. Otero County: Orogrande district, with gold-bearing contact metamorphic ores; Sacramento and Tularosa districts. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti district, rare. San Miguel County: El Porvenir district, with tungsten and molybdenum minerals; Rociada, Tecolote, and Willow Creek districts. Santa Fe County: Cerrillos, Santa Fe, New Placers, and Old Placers districts. Sierra County: Caballos Mountains, Chloride, Hermosa, Hillsboro, Kingston, and Tierra Blanca districts, chiefly with silver ores; Goodfortune Creek district; Grandview Canyon district, with bismuth ore; Salinas Peak district. Socorro County: Hansonburg district; Joyita Hills and Lemitar Mountains districts, very small; Magdalena and North Magdalena districts; Scholle district, in "Red Beds"; Water Canyon district. Taos County: Picuris, Red River, and Twining districts. Valencia County: Zuni Mountains.

Chalcotrichite. A variety of cuprite.

Chalmersite. Magnetic copper-iron sulfide ($Cu_2S \cdot Fe_4S_5$). Grant County: Hanover-Fierro district, with contact-metamorphic iron ores.

Chrysocolla. Impure hydrated copper silicate ($CuSiO_3 \cdot 2H_2O$). Catron County: Mogollon district, with silver ores. Colfax County: Elizabethtown district, with gold ores. Dona Ana County: Organ district. Grant County: Burro Mountains and Santa Rita districts. Hidalgo County: Apache No. 2, Lordsburg, and San Simon districts. Lincoln County: Jicarilla district, with gold ores. Otero County: Orogrande district. Sandoval County: Nacimiento district. San Miguel County: Willow Creek district. Santa Fe County: Santa Fe Mountains. Sierra County: Sulphur Canyon district. Socorro County: Joyita Hills district, rare; Ladron Mountains; Magdalena district, rare; Mill Canyon and Mockingbird Gap districts; North Magdalena district, common; Ojo Caliente and San Lorenzo districts. Taos County: Picuris district.

Copper (native). An element (Cu). Grant County: Burro Mountains district, rare; Central area; Pinos Altos district, rare; Santa Rita district, important. Rio Arriba County: Bromide district, rare. San Miguel County: Willow Creek district. Sierra County: Hillsboro district. Socorro County: Magdalena, Mock-

ingbird Gap, San Lorenzo, and Water Canyon districts, rare. Valencia County: Zuni Mountains, rare.

Copper arsenates. See under arsenic minerals.

Copper-pitch ore. This is a secondary material of complex character and uncertain composition (Emmons, 1917, pp 185 f). It may contain oxides of copper, zinc, and manganese, with considerable water and silica. Catron County: Mogollon district, with silver ores. Hidalgo County: Fremont district. Otero County: Orogrande district. Socorro County: Magdalena district (?).

Covellite (indigo copper). Copper sulfide (CuS). Occurs as traces or very small quantities in all its occurrences except one, as noted below. Grant County: Central area. Rio Arriba County: Bromide district. Sierra County: Goodfortune Creek district. Socorro County: Hansonburg, Joyita Hills, Ladron Mountains, Magdalena, North Magdalena, Scholle, and Water Canyon districts; important in Mill Canyon district.

Probably occurs in all copper deposits, at least in microscopic amounts, but has been reported only from the above districts.

Cuprite (red copper). Copper oxide (Cu_2O). Catron County: Mogollon district, rare. Colfax County: Elizabethtown district, with gold ores. Grant County: Burro Mountains and Santa Rita districts. Lincoln County: Jicarilla district, with cupriferous gold ores. Rio Arriba County: Bromide district. San Miguel County: Rociada district. Sierra County: Caballos Mountains district; Hillsboro district, chalcotrichite. Socorro County: Magdalena, Mockingbird Gap, San Lorenzo, and Water Canyon districts; important in Mill Canyon district. Taos County: Picuris district.

Cuprodescloizite. See under vanadium minerals.

Dioptase. Hydrated copper silicate (H_2CuSiO_4). Grant County: Santa Rita district.

Domeykite. Copper arsenide (Cu_3As). Grant County: Central area (?) and Pinos Altos district (?).

Enargite. Sulfarsenate of copper (Cu_3AsS_4). Grant County: Central area (?) and Pinos Altos district (?). Socorro County: Hansonburg district (?), trace.

Gerhardtite. Basic copper nitrate [$Cu(NO_3)_2 \cdot 3Cu(OH)_2$]. Socorro County: Magdalena district (?).

Libethenite. Basic copper phosphate [$Cu_3P_2O_8 \cdot Cu(OH)_2$]. Grant County: Santa Rita district.

Linarite. Copper-lead sulfide [$PbCu \cdot (OH)_2SO_4$]. Socorro County: Hanson-burg district.

Malachite. Basic copper carbonate [$CuCO_3 \cdot Cu(OH)_2$]. Occurs in practically all districts where copper minerals are present and is an important ore mineral in deposits in sandstone. Catron County: Mogollon district. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Hembrillo and Organ districts. Grant County: Burro Mountains, Central, Fierro, Pinos Altos, and Santa Rita districts. Guadalupe County: Pastura district, important. Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, and San Simon districts. Lincoln County: Estey and Jicarilla districts. Luna County: Florida Mountains district. Mora County: Coyote district. Otero County: Orogrande district; Tularosa and Sacramento districts, important. Rio Arriba County: Abiquiu, Bromide, and Gallina districts. Sandoval County: Nacimiento

and Placitas districts. San Miguel County: El Porvenir district, with tungsten and molybdenum minerals; Rociada district; Tecolote district, important; Willow Creek district. Santa Fe County: Glorieta and La Bajada districts. Sierra County: Caballos Mountains, Chloride, Goodfortune Creek, Grandview Canyon, Hillsboro, Salinas Peak, and Sulphur Canyon districts. Socorro County: Chupadera, Hansonburg, Jones Camp, Joyita Hills, Ladron Mountains, Magdalena, Mill Canyon, Mockingbird Gap, North Magdalena, Ojo Caliente, San Lorenzo, Socorro Peak, and Water Canyon districts; San Jose district, rare in gold-silver veins; Rayo and Scholle districts, in sandstone copper deposits. Taos County: Picuris district. Valencia County: Zuni Mountains.

Melaconite. A variety of tenorite.

Melanochalcite. Copper oxide similar to melaconite. Grant County: Burro Mountains district (?).

Pearceite. See under silver minerals.

Rickardite. See under tellurium minerals.

Tennantite (gray copper). Sulfarsenite of copper ($Cu_8As_2S_7$). Hidalgo County: San Simon district (?). Socorro County: Hansonburg district, most important copper mineral.

Tenorite. Copper oxide (CuO). Not a common mineral. Grant County: Burro Mountains district, melaconite (?); Santa Rita district, melaconite. Hidalgo County: Fremont district (?). Socorro County: Magdalena and San Lorenzo districts.

Tetrahedrite (gray copper, fahlerz). Sulfantimonite of copper ($Cu_8Sb_2S_7$). Catron County: Mogollon district, with silver ores. Dona Ana County: Organ district, in silver-lead veins. Hidalgo County: Lordsburg (Pyramid) district, reported; San Simon district. Rio Arriba County: Bromide district. San Miguel County: Willow Creek district. Taos County: Picuris district (?).

GOLD

Gold (native). An element (Au).

Gold occurs in lode deposits as follows:

Catron County: Mogollon district, rare. Colfax County: Baldy and Elizabethtown districts. Dona Ana County: Gold Camp district. Grant County: Steeple Rock district. Hidalgo County: Steins Pass and Sylvanite districts. Lincoln County: Jicarilla, Nogal, and White Oaks districts. Otero County: Orogrande district. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti district. Santa Fe County: New Placers and Old Placers districts. Sierra County: Chloride, Hillsboro, and Tierra Blanca districts. Socorro County: Magdalena, Mill Canyon, and Water Canyon districts, rare; Rosedale and San Jose districts. Taos County: Anchor, Red River, and Twining districts.

Gold occurs also as a constituent of base-metal ores in most districts, constituting a very important part of the value of some ores. The districts in which gold occurs in auriferous sulfides in appreciable proportions, in addition to those listed above, are as follows:

Bernalillo County: Tijeras district. Catron County: Mogollon district. Colfax County: Cimarroncito district. Dona Ana County: Organ district. Grant County: Burro Mountains, Central, Gold Hill, Malone, Pinos Altos, Santa

Rita, and White Signal districts. Hidalgo County: Apache No. 2, Fremont, Lordsburg, and Red Hill districts. Lincoln County: Gallinas Mountains district. Luna County: Tres Hermanas and Victorio districts. Otero County: Tularosa district. Sandoval County: Jemez Springs and Placitas districts. San Miguel County: Rociada and Willow Creek districts. Santa Fe County: Santa Fe district. Sierra County: Tierra Blanca district. Socorro County: Cat Mountain, Magdalena, Mill Canyon, North Magdalena, San Mateo Mountains, and Socorro Peak districts. Taos County: Picuris, Rio Hondo, and Red River districts.

Gold is reported (Schrader et al., 1917, p 212) also in the Guadalupe Mountains, in Chaves, Eddy, and Otero Counties.

Gold in placer deposits occurs as follows:

Bernallilo County: Coyote Canyon district. Chaves County: on the Rio Hondo. Colfax County: Cimarroncito, Elizabethtown, and Ponil districts. Grant County: Gold Camp, Malone, and Pinos Altos districts. Hidalgo County: Lords-burg and Sylvanite districts. Lincoln County: Gallinas, Jicarilla, Nogal, and White Oaks districts, and along the Rio Hondo. Otero County: Orogrande district, dry placers. Rio Arriba County: Abiquiu and Hopewell districts. Sandoval County: Placitas district. San Miguel County: Willow Creek district. Santa Fe County: New Placers, Old Placers, and Santa Fe districts. Sierra County: Hillsboro and Pittsburg districts, and Caballos Mountains opposite Derry. Taos County: Red River and Rio Hondo districts, and a number of places along the Rio Grande.

Petzite. Silver-gold telluride [$(Ag,Au)_2Te$]. A telluride, believed to be petzite, occurs in the Red River district, Taos County.

IRON

Arsenopyrite. See under arsenic minerals.

Columbite. See under tantalum minerals.

Hematite. Iron oxide (Fe_2O_3). Common in oxidized ore throughout the State. The distribution of specularite, the crystalline variety, is listed separately. Mined at Boston Hill, Grant County, with manganese and other iron oxides. Occurs in the following districts, possibly in commercial quantities:

Colfax County: Elizabethtown district, prospected at Iron Mountain. Santa Fe County: formerly mined in Glorieta district. Socorro County: Iron Mountain district (?).

Jarosite. Basic potassium-iron sulfate [$K_2Fe_6(OH)_{12}(SO_4)_4$]. Grant County, Central area. Sierra County: Goodfortune Creek and Grandview Canyon districts, common. Socorro County: Hansonburg and Magdalena districts. Undoubtedly occurs in other districts also, but probably has been included in reports under the term "limonite."

Limonite (brown hematite). Includes all the hydrated iron oxides. Limonite is a common oxidation product of iron-bearing minerals and therefore generally occurs in the oxidized zone of all lode deposits. Workable bodies of limonite occur in the Zuni Mountains, Valencia County.

Magnetite (magnetic iron ore). Iron oxide (Fe_3O_4). The principal mineral of New Mexico's iron ores. Occurs most commonly in contact-metamorphic deposits. Colfax County: Cimarroncito and Elizabethtown districts, in aurif-

erous contact-metamorphic ores. Grant County: Big Burro Mountains; Chloride Flat district, with silver ores; Hanover-Fierro district, important; Santa Rita district. Lincoln County: Capitan Mountain, Gallinas Mountains, Jicarilla (?), and Mite Oaks (?) districts, in iron-ore deposits. Otero County: has been mined in Orogrande district. Rio Arriba County, Bromide district; forms an iron-ore deposit in Hopewell district. Santa Fe County: Old Placers district, in gold-quartz veins. Sierra County: Chloride district, possible iron-ore deposit. Socorro County: principal mineral at Jones Camp and elsewhere on the Chupadera Mesa; Magdalena district, with lead-zinc deposits.

Melanterite (copperas). Hydrous iron sulfate ($FeSO_4 \cdot 7H_2O$). Socorro County: Magdalena district, uncommon.

Plumbojarosite. See under lead minerals.

Pyrite (iron pyrites, fool's gold). Iron sulfide (FeS_2). Pyrite is the most common metallic constituent of lode deposits, in some of which it is auriferous. Catron County: Mogollon district. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Gold Camp and Organ districts. Grant County: Burro Mountains, Carpenter, Central, Hanover-Fierro, Fleming, Gold Hill, Pinos Altos, Santa Rita, Steeple Rock, and White Signal districts. Hidalgo County: Apache No. 2, Hachita, Lordsburg, San Simon, and Steins Pass districts. Lincoln County: Estey district, with copper in Red Beds; Jicarilla, Nogal, and White Oaks districts. Luna County: Cooks Peak, Tres Hermanas, and Victorio districts. Otero County: Orogrande district; Tularosa district, with copper in Red Beds. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti district. San Miguel County: Rociada and Willow Creek districts; Tecolote district, with copper in Red Beds. Santa Fe County: New Placers (rare) and Old Placers districts. Sierra County: Chloride, Goodfortune Creek, Grandview Canyon, Hermosa, Hillsboro, and Kingston districts. Socorro County: Ladron Mountains, Magdalena, Mill Canyon, Rosedale (?), San Jose, and Water Canyon districts; Scholle district, with copper in Red Beds. Taos County: Anchor, Picuris, Red River, and Twining districts. Valencia County: Zuni Mountains.

Pyrrhotite (magnetic pyrites). Iron sulfide (Fe_7S_8). Colfax County: Elizabethtown district, locally with pyrite and other minerals in cupriferous gold deposits. Grant County: Santa Rita district. Santa Fe County: New Placers district; rare with chalcopyrite in contact-metamorphic ores; Santa Fe district, with copper ore in amphibolite. San Miguel County: Willow Creek district. Socorro County: Magdalena district (?), rare.

Specularite (specular iron, micaceous hematite). A crystalline variety of hematite, iron oxide (Fe_2O_3). Specularite is always a primary mineral and is common in contact-metamorphic deposits generally associated with magnetite. Catron County: Mogollon district, occasionally in copper-bearing veins; Taylor Creek district, with cassiterite. Colfax County: Cimarroncito and Elizabethtown districts. Dona Ana County: Organ district. Grant County: Burro Mountains and Central districts; Hanover-Fierro district, with magnetite in iron ore; Pinos Altos district, with copper and gold ores; Santa Rita district, sparingly with copper ores; Steeple Rock district, with auriferous pyrite. Hidalgo County: Lordsburg district, in copper-tourmaline veins. Luna County: Tres Hermanas district. Otero County: Orogrande district, important in iron ore. Rio Arriba County: Bromide and Hopewell districts, locally. Santa Fe County: New

Placers district; Old Placers district, with gold-quartz veins. Sierra County: Chloride district, with magnetite; Lake Valley district, in gold-quartz veins, rare. Socorro County: Ladron Mountains district; Magdalena district, abundant in contact zone. Taos County: Red River district.

LEAD

Altaite. See under tellurium minerals.

Anglesite. Lead sulphate ($PbSO_4$). Anglesite is common in deposits which contain galena, from which it is derived. Dona Ana County: Organ district. Grant County: Central area. Luna County: Cooks Peak and Victorio (?) districts. Sierra County: Caballos Mountains district. San Miguel County: Willow Creek district. Socorro County: Hansonburg, Joyita Hills, Magdalena, Mockingbird Gap, and Water Canyon districts. Anglesite undoubtedly occurs in most other districts in which galena is present, but probably as an inconspicuous coating.

Bournonite. See under copper minerals.

Cerussite (white lead ore). Lead carbonate ($PbCO_3$). Cerussite is most common in lead deposits in limestones. Dona Ana County: Organ district. Grant County: Central, Georgetown, Gold Hill, and Hanover-Fierro districts. Hidalgo County: Fremont, Hachita, and Lordsburg districts; San Simon district, principal ore mineral. Luna County: Cooks Peak district, principal ore mineral; Florida Mountains, Fremont, and Victorio (?) districts. San Miguel County: Willow Creek district. Santa Fe County: New Placers district, with manganese ore. Sierra County: Caballos Mountains and Chloride districts, unimportant; Goodfortune Creek district, small; Hermosa and Kingston districts, principal ore mineral; Hillsboro district, with cerussite; Lake Valley district, small, very rich in silver; Salinas Peak and Tierra Blanca districts. Socorro County: Chupadera district, in Red Beds; Hansonburg, Joyita Hills, Lemitar Mountains, Magdalena, Mill Canyon, Mockingbird Gap, North Magdalena, Socorro Peak, and Water Canyon districts. Taos County: Red River district. Valencia County: Zuni Mountains.

Massicot. Lead monoxide (PbO). Grant County: Chloride Flat district (?).

Melanotekite. Lead-iron silicate ($3PbO \cdot 2Fe_2O_3 \cdot 3SiO_2$). Rare. Sierra County: Hillsboro district (?).

Mimetite. Lead chlorarsenate [$Pb_4(PbCl)(AsO_4)_3$]. Socorro County: Socorro Peak district.

Minium (red lead). Lead oxide (Pb_3O_4). An uncommon mineral. Sierra County: Hillsboro district, on the Stuck claims.

Plumbojarosite. Basic lead-iron sulfate [$PbFe_6(OH)_{12}(SO_4)_4$]. Grant County: Central area. Luna County: Cooks Peak district. Socorro County: Magdalena and Water Canyon districts. Plumbojarosite is more common than at one time supposed and probably occurs in other districts.

Pyromorphite (green lead ore). Lead chlorophosphate [$(PbCl)Pb_4(PO_4)_3$]. Grant County: Central area. Sierra County: Caballos district, reported.

Vanadinite. See under vanadium minerals.

Wulfenite. See under molybdenum minerals.

LITHIUM

Lithium. A member of the alkali family; the lightest of the known metals. Only recently has its importance in the metallic field been recognized. It has many uses, serving principally as an alloy of aluminum and as an essential element in the welding fluxes for aluminum. Lepidolite and spodumene are the chief ores of lithium; both are found in abundance in some of the pegmatites of northern New Mexico. Production has come chiefly from Taos and San Miguel Counties.

MANGANESE

The primary ore of many deposits includes an appreciable amount of manganese. On oxidation the manganese is converted to the different oxides and is concentrated in this form by residual enrichment. Many of the manganese deposits of New Mexico have been formed in this manner.

Alabandite. Manganese sulfide (MnS). An uncommon mineral. Santa Fe County: New Placers district. Sierra County: Kingston district, fairly common.

Ankerite. A carbonate of calcium, magnesium, iron, and variable proportions of manganese [$CaCO_3$ • $(Mg,Fe,Mn)CO_3$]. Common in the Silver City district, Grant County, and probably occurring in the primary ore of other manganese deposits.

Chalcophanite. See under zinc minerals.

Mallardite. Hydrous manganese sulfate ($MnSO_4$ • $7H_2O$). Sierra County: Lake Valley district (?).

Manganiferous calcite. Black calcite containing manganese oxide occurs in many manganese deposits. The districts in which this material is prominent are: Luna County: Little Florida Mountains district. Sierra County: Derry Manganese district. Socorro County: Luis Lopez and Magdalena Mountains Manganese districts.

Manganite (gray manganese ore). Hydrous manganese oxide (Mn_2O_3 • H_2O). Dona Ana County: Rincon Manganese district (?). Grant County: Hanover-Fierro and Silver City districts. Luna County: Little Florida Mountains. Sierra County: Lake Valley district, mined with silver ore and independently as manganese ore.

Psilomelane. Manganese hydrate, probably H_4MnO_5. Dona Ana County: Rincon Manganese district. Grant County: Cap Rock Mountain Manganese district. Luna County: Cooks Range Manganese, Florida Mountains, and Little Florida Mountains districts. Santa Fe County: Santa Fe Manganese district. Sierra County: Hot Springs district; Lake Valley district, mined for silver and independently as an ore of manganese. Socorro County: Luis Lopez Manganese district; Magdalena district, with oxidized lead-zinc ores; Luis Lopez-Socorro Manganese, Magdalena Mountains Manganese, and San Lorenzo districts.

Pyrolusite. Manganese dioxide (MnO_2). Very common in oxidized zones, generally associated with limonite. Catron County: Mogollon district. Grant County: Burro Mountains, Chloride Flat, Hanover-Fierro, and Silver City districts. Hidalgo County: Fremont, Lordsburg, and San Simon districts. Lincoln County: White Oaks district. Luna County: Little Florida Mountains Manganese district. Santa Fe County: New Placers district, with lead

and manganese ores; Santa Fe Manganese district. Sierra County: Derry Manganese district; Hillsboro district, with lead and manganese ores; Kingston district, with silver-lead, copper, and manganese ores; Lake Valley district with silver and manganese ores. Socorro County: Magdalena district, with oxidized lead-zinc ores; Magdalena Mountains Manganese district; Mill Canyon district, with manganiferous calcite; Luis Lopez-Socorro Manganese, Mockingbird Gap, San Lorenzo, and Water Canyon districts.

Rhodochrosite. Manganese carbonate ($MnCO_3$). Sierra County, Kingston district.

Wad. A mixture of manganese oxides. Grant County: Hanover-Fierro and Silver City districts. Luna County: Little Florida Mountains district. Sierra County: Derry Manganese district; Hillsboro district, with oxidized lead and manganese ores; Hot Springs district; Kingston and Lake Valley districts, with oxidized ores. Socorro County: Magdalena district, with oxidized lead-zinc ores; Magdalena Mountains Manganese district; Ojo Caliente district, with oxidized lead ore; Ladron Mountains and San Lorenzo districts.

MOLYBDENUM

Molybdenite. Molybdenum sulfide (MoS_2). Colfax County: Baldy district. Dona Ana County: Organ district, reported. Grant County: Burro Mountains, reported; Hanover-Fierro district, occasionally with iron ore; Santa Rita district, small quantities with copper ore. Hidalgo County: Lordsburg district, sparingly. Rio Arriba County: Bromide district, locally. San Miguel County: El Porvenir district, with copper and tungsten minerals, mined; Rociada district, reported. Santa Fe County: Old Placers (?) and Santa Fe districts. Taos County: Red River district, important deposits; Twining district.

Molybdite (ferrimolybdite). Hydrous ferric molybdate ($Fe_2O_3 \cdot 3MoO_3 \cdot 7H_2O$). San Miguel County: El Porvenir district, with molybdenite. Taos County: in the oxidized zone of the Red River district molybdenum deposit.

Wulfenite. Lead molybdate ($PbMoO_4$). Common in some oxidized lead ores. Dona Ana County: Organ district, has been mined as molybdenum ore. Grant County: Central area. Hidalgo County: Lordsburg district. Lincoln County: Gallinas district. Luna County: Victorio district. Santa Fe County: Cerrillos district, reported. Sierra County: Caballos Mountains district, reported; Hillsboro district, prominent.

NICKEL

Annabergite. Hydrous nickel arsenate ($Ni_3As_2O_8 \cdot 8H_2O$). Grant County: Black Hawk district.

Chloanthite-smaltite. Chloanthite is essentially nickel diarsenide ($NiAs_2$). Smaltite is essentially cobalt diarsenide ($CoAs_2$). Each usually contains some of the other. Grant County: Black Hawk district, with native silver and other silver minerals.

Niccolite (copper nickel). Nickel arsenide (NiAs). Occurrence same as chloanthite-smaltite.

Nickel-skutterudite. Nickel-cobalt-iron arsenide [$(Ni,Co,Fe)As_3$]. Grant County: Black Hawk district, type locality.

SILVER

Although silver is present in the form of recognizable silver minerals in certain types of deposits, most of the silver production of the State comes from base-metal deposits which carry the silver combined with certain of the base-metal sulfides.

Argentite (silver glance). Silver sulfide (Ag_2S). Argentite is usually a product of secondary enrichment. Catron County: Mogollon district. Dona Ana County: Organ district, rare. Grant County: Black Hawk, Chloride Flat (?), Fleming, Georgetown, Lone Mountain, Pinos Altos, Steeple Rock, and Telegraph districts. Hidalgo County: Lordsburg (?) and Steins Pass districts. Luna County: Florida Mountains district. Sandoval County: Cochiti district. San Miguel County: Willow Creek district. Sierra County: Chloride, Hermosa, Kingston, Lake Valley (rare), and Tierra Blanca districts. Socorro County: North Magdalena and Socorro Peak districts. Taos County: Picuris district, reported.

Bromyrite. Silver bromide (AgBr). Grant County: Georgetown district. Rio Arriba County: Bromide district. Sierra County: Tierra Blanca district, not common.

Cerargyrite (horn silver). Silver chloride (AgCI). Catron County: Mogollon district. Dona Ana County: Organ district, rare. Grant County: Black Hawk, Burro Mountains, Chloride Flat, Fleming, Georgetown, Lone Mountain, and Pinos Altos districts. Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, and Steins Pass districts. Luna County: Florida Mountains district. Rio Arriba County: Bromide district. Sierra County: Chloride, Hermosa, and Hillsboro districts; Kingston district, locally; Lake Valley district, chief silver mineral, in large bodies; Tierra Blanca district, not common. Socorro County: San Jose and Socorro Peak districts. Taos County: Picuris district.

Embolite. Silver chlorobromide [Ag(Br,CI)]. Sierra County: Lake Valley district. Socorro County: Socorro Peak district (?).

Hessite. Silver telluride (Ag_2Te). Sierra County: Tierra Blanca district, principal mineral at the Lookout mine.

Iodyrite. Silver iodide (AgI). Grant County: Georgetown district, reported. Sierra County: Lake Valley district.

Pearceite. Sulfarsenite of silver ($9Ag_2S \cdot As_2S_3$). Socorro County: Magdalena district.

Petzite. See under gold minerals.

Polybasite. Sulfantimonite of silver ($9Ag_2S \cdot Sb_2S_3$). Grant County: Telegraph district (?).

Proustite (light-ruby silver). Sulfarsenite of silver ($3Ag_2S \cdot As_2S_3$). Grant County: Georgetown district. Sierra County: Kingston and Lake Valley districts. San Miguel County: Willow Creek district.

Pyrargyrite (dark-ruby silver). Sulfantimonite of silver ($3Ag_2S \cdot Sb_2S_3$). Catron County: Mogollon district, rare. Grant County: Black Hawk, Georgetown, and Gold Hill districts. Sierra County: Kingston district.

Silver (native). An element (Ag). Native silver is usually the result of secondary enrichment. Catron County: Mogollon district, rare. Grant County: Black Hawk, Chloride Flat, Fleming, Georgetown, Gold Hill, Lone Mountain,

and Pinos Altos districts. Hidalgo County: Lordsburg and San Simon districts. Luna County: Victorio district. Sierra County: Chloride, Hermosa, Hillsboro, Kingston, Lake Valley (rare), and Tierra Blanca districts. Socorro County: Cat Mountain (reported), Magdalena, North Magdalena (reported), San Jose, and Socorro Peak districts. Valencia County: Copperton district.

Stephanite (brittle silver ore). Sulfantimonite of silver ($5A_2S \cdot Sb_2S_3$). Hidalgo County: Fremont district (?). Rio Arriba County: Bromide district. Sierra County: Lake Valley district. Socorro County: San Jose district (?).

Stromeyerite. Silver-copper sulfide [$(Ag,Cu)_2S$]. Catron County: Mogollon district, important ore mineral.

Xanthoconite (rittingerite). Silver sulfarsenate ($3Ag_2S \cdot As_2S_5$) Santa Fe County: Cerrillos district.

TANTALUM

Columbite-tantalite. Niobate and tantalate of iron and manganese [$(Fe,Nm)(Nb,Ta)_2O_6$]. Rio Arriba County: Petaca district, mined. San Miguel County: Rociada, Ribera, and Tecolote districts. Tabs County: Harding mine.

TELLURIUM

Tellurium occurs in New Mexico chiefly in combination with some other more valuable element.

Altaite. Lead telluride (PbTe). Reported from Organ Mountains, Dona Ana County.

Hessite. See under silver minerals.

Petzite. See under gold minerals.

Rickardite. Copper telluride (Cu_4Te_3). Reported from Organ Mountains, Dona Ana County.

Tellurium (native). An element (Te). Cation County: Mogollon district. Reported from Burro Mountains, Grant County, and said to be gold-bearing.

Tetradymite. See under bismuth minerals.

TIN

Cassiterite (tin-stone, tin ore, stream tin). Tin oxide (SnO_2). Catron County: Taylor Creek district, in lode and placer deposits. Sierra County: Chloride district, in extrusive porphyries and as stream tin.

TUNGSTEN

Cuprotungstite. Hydrous copper tungstate (CuWO4 • 2H2O). Rio Arriba County: Rinconada district (?), with wolframite.

Ferberite. Iron tungstate ($FeWO_4$). Colfax County: Elizabethtown district. San Miguel County: El Porvenir district, with scheelite and bismuth, molybdenum, and copper minerals.

Hübnerite. Manganese tungstate ($MnWO_4$). Hidalgo County: Hachita district (?). Lincoln County: Nogal (Parsons) district; White Oaks district, mined

with gold ore and as a tungsten ore. Luna County: Victorio district, with wolframite.

Scheelite. Calcium tungstate ($CaWO_4$). Hidalgo County: Apache No. 2 district, in contact-metamorphic ore, in considerable quantities at one place; Fremont district (?), at the Daisy mine. Luna County: Victorio district (?), with wolframite. San Miguel County: El Porvenir district. Sierra County: Grandview Canyon district, with bismuth ore. Socorro County: San Andres Mountains districts, with bismuth ore.

Wolframite. Iron manganese tungstate [$(Fe,Mn)WO_4$]. Colfax County: Baldy district. Hidalgo County: Hachita district, reported with argentiferous galena and other sulfides. Lincoln County: White Oaks district. Luna County: Victorio district, small quantity mined. Rio Arriba County: Rinconada district. Taos County: Picuris district.

Production of tungsten ore has been reported (Finlay, 1922, p 82) from the Orogrande district, but the mineralogy of the occurrence is not known.

URANIUM

Autunite (lime uranite). Hydrous calcium-uranium phosphate [$Ca(UO_2)_2P_2O_8 \cdot 8H_2O$]. Grant County: White Signal district, with torbernite. Socorro County: San Lorenzo district (?).

Calcocarnotite. McKinley and Valencia Counties: Grants district.

Carnotite. Hydrous potassium-uranium vanadate ($K_2O \cdot 2U_2O_3 \cdot V_2O_5 \cdot 3H_2O$). With vanadium minerals at Carrizo Mountains, Catron County. Socorro County: Scholle district. San Juan County: Chuska district. Oxides of uranium and vanadium have been reported from one place in the Cochiti district, Sandoval County, but the mineralogy of the occurrence is not known. It is probably carnotite.

Gummite. [$(Pb,Ca,Ba)O \cdot 3UO_3 \cdot SiO_2 \cdot 5H_2O$]. An alteration product of uraninite. Rio Arriba County: Petaca district, in pegmatite with other radioactive minerals.

Samarskite. A columbate and tantalate of iron, calcium, uranium, cerium, yttrium, etc. Rio Arriba County: Petaca district, in pegmatite.

Torbernite (copper uranite). Hydrous copper-uranium phosphate [$Cu(UO_2)_2P_2O_8 \cdot 12H_2O$]. Grant County: White Signal district, with autunite. Socorro County: San Lorenzo district (?).

Tyuyamunite. A calcium-uranium vanadate [$Ca(UO_2)_2(VO_4)_2 \cdot nH2O$]. McKinley County: all districts.

Uraninite (pitchblende). A complex uranium mineral containing also rare earths, radium, lead, helium, nitrogen, and other elements. Rio Arriba County: Petaca district, in pegmatite with samarskite and other uranium minerals. McKinley and Valencia Counties: Grants district, with calcocarnotite.

Uranophane. Hydrous calcium-uranium silicate ($CaO \cdot 2UO_3 \cdot 2SiO_2 \cdot 6H_2O$). Rio Arriba County: Petaca district, with other uranium minerals in pegmatite. Socorro County: San Lorenzo district (?).

Other new complex minerals of uranium are being identified frequently in deposits in McKinley, San Juan, and Valencia Counties.

VANADIUM

Vanadium minerals are common in New Mexico in certain oxidized lead deposits and with most of the uranium minerals.

Copper vanadate. Torrance County: Scholle district, with copper ores in Red Beds, mineralogic character unknown.

Cuprodescloizite (psittacinite). A basic vanadate of lead, zinc, and copper [$2PbO \cdot 2(Cu,Zn)O \cdot V_2O_5 \cdot H_2O$]. Grant County: Bayard district, near Vanadium, with vanadinite. Otero County: Sacramento district, with galena ores in Red Beds. Sierra County: Caballo Mountains, in lead-vanadium ores. Socorro County: Hansonburg district.

Descloizite. Basic lead-zinc vanadate [$4(Pb,Zn)O \cdot V_2O_5 \cdot H_2O$]. Grant County: Georgetown district. Sierra County: Lake Valley district. Socorro County: North Magdalena district.

Endlichite. A variety of vanadinite containing considerable arsenic. Grant County: Central area. Sierra County: Hillsboro and Lake Valley districts.

Vanadinite. Lead chlorovanadate ($9PbO \cdot 3V_2O_5 \cdot PbCl_2$). The most common vanadium mineral in New Mexico. Dona Ana County: Black Mountain district, associated with galena and barite; Memphis mine, Organ Mountains. Grant County: Georgetown district, with silver ores; at Vanadium, near Santa Rita. Sierra County: Caballos Mountains, Hillsboro, and Lake Valley districts. Socorro County: North Magdalena district, in lead veins in volcanic rocks. Valencia, McKinley, and San Juan Counties: with uranium ores.

ZINC

Aurichalcite. Basic zinc-copper carbonate [$2(Zn,Cu)CO_3 \cdot 3(Zn,Cu)(OH)_2$]. Socorro County: Magdalena district.

Calamine. Hydrous zinc silicate (H_2ZnSiO_5). Grant County: Hanover-Fierro district, important; Central and Pinos Altos districts. Luna County: Tres Hermanas district, important. Socorro County: Magdalena district; Ojo Caliente district, rare.

Chalcophanite. Hydrous manganese-zinc oxide. [$(Mn,Zn)O \cdot 2MnO_2 \cdot 2H_2O$]. A rare mineral, valuable as mineralogic specimens. Socorro County: Magdalena district, mined with smithsonite.

Gahnite (zinc-spinel). Zinc aluminate ($ZnAl_2O_4$). Santa Fe County: Cerrillos district.

Goslarite. Hydrous zinc sulfate ($ZnSO_4 \cdot 7H_2O$). Grant County: Central area. Sierra County: Kingston district. Socorro County: Magdalena and Water Canyon districts.

Hydrozincite (zinc bloom). Basic zinc carbonate [$3Zn(OH)_2 \cdot 2ZnCO_3$]. Luna County: Tres Hermanas district, with willemite and smithsonite. Socorro County: Magdalena district, with smithsonite.

Monheimite. Ferriferous smithsonite. Occurs in the Magdalena district, Socorro County, and probably also in other districts where smithsonite is common.

Smithsonite (dry-bone ore). Zinc carbonate ($ZnCO_3$). The common product resulting from the oxidation of zinc ores in limestone. Grant County: Carpenter and Central districts; Hanover-Fierro district, important; Pinos Altos district.

Luna County: Cooks Peak, Florida Mountains, and Tres Hermanas districts. San Miguel County: Willow Creek district. Santa Fe County: Cerrillos district. Socorro County: Magdalena district, important as ore and for museum specimens; Lemitar Mountains district.

Sphalerite (zinc blende, blende, black jack, mock-lead, false galena). Zinc sulfide (ZnS). Catron County: Mogollon district, with silver-copper ores. Dona Ana County: Organ district. Grant County: Burro Mountains, Carpenter, and Central districts; Hanover-Fierro district, very important; Gold Hill, Pinos Altos, Steeple Rock, and White Signal districts. Hidalgo County: Fremont, Hachita, Lordsburg, and Steins Pass districts. Lincoln County: Nogal district. Luna County: Cooks Peak, Florida Mountains, and Tres Hermanas districts. Rio Arriba County: Bromide district, rare; Hopewell district. Sandoval County: Cochiti district. San Miguel County: Rociada district (?); Willow Creek district, most important mineral. Santa Fe County: Cerrillos, New Placers, and Santa Fe districts. Sierra County: Kingston and Lake Valley districts. Socorro County: Magdalena district, very important; Lemitar Mountains, Mockingbird Gap, and Water Canyon districts. Taos County: Red River and Twining districts.

Tallow clay. A brown tallowlike clay containing zinc, locally in economic amounts. Socorro County: Magdalena district.

Willemite. Zinc silicate (Zn_2SiO_4). An uncommon mineral. Grant County: Central area. Luna County: Tres Hermanas district, in oxidized zinc ores. Socorro County: Magdalena district, at one locality, associated with cerussite and native gold; Socorro Peak district (?). Probably more common as an oxidation product of zinc minerals than generally supposed.

Zincite (red oxide of zinc). Zinc oxide (ZnO). Luna County: Tres Hermanas district, reported.

RARE EARTHS

Rare-earth minerals are scattered widely over the State. Their most common ores are monazite (Ce, La, Pr, Nd)PO_4 (with thorium, yttrium, and silica) and bastnaesite (Ce, La, Di, etc.)CO_3. Not until recently have these ores become of importance in New Mexico.

Bastnaesite. Lincoln County: Gallinas district, occurring with purple fluorspar.

Monazite. Rio Arriba County: Petaca district. San Miguel County: Manzanares Creek area and Ribera district, in pegmatites. This mineral also occurs in many granites, being especially noticeable in zones of alteration and along contacts.

Mining Districts in New Mexico

BERNALILLO COUNTY

Bernalillo County, in the central part of the State, lies astride the Rio Grande. Until Los Alamos County was established in 1949, it was the smallest county in New Mexico. It has an area of 1,163 square miles, and the 1950 population was 146,013. Albuquerque, the largest city in the State, is the county seat.

The portion of the county west of the Rio Grande lies at the east edge of the Plateau province and is underlain mainly by Cretaceous sedimentary rocks. The river valley or trough contains Tertiary and Quaternary sediments and volcanic rock. The part east of the river contains the westward facing scarps of the Sandia and Manzano Mountains and other portions of those mountain ranges.

The known occurrences of metallic ores are restricted to mountainous areas, and production has been of only slight economic importance. The only metal mining district, the Tijeras Canyon district, has been inactive since 1941.

TIJERAS CANYON DISTRICT

This district includes the Coyote, Hell Canyon, Soda Springs, and La Luz subdistricts in the Sandia and Manzano Mountains, which are separated by Tijeras Canyon.

The ores found are those of lead, silver, and gold. Exploration and development work was carried on for many years, but production has been slight. Except for annual assessment work on a few unpatented claims, the district has been idle in recent years.

TABLE 1. PRODUCTION OF METALS IN BERNALILLO COUNTY, 1910-1954

Year	Gold (value)	Silver (ounces)	Lead (pounds)	Total Value
1910	$ 490	134	42,638	$2,792
1938	154	3	—	156
1940	245	7	—	278
1941	140	1,014	—	861
1942-1954*	—	—	—	—
Total	$l,029	1,158	42,638	$4,087

* No production

The ore occurs in veins in granite and allied rocks of Precambrian age and in overlying Magdalena (Pennsylvanian) limestone (Ellis, 1922, p 40). The veins are associated with a system of faults which traverse the west front of the mountains. At the present time almost the entire area

covered by this mining district is included in the Sandia military base and is not accessible to prospector or operator.

CATRON COUNTY

Catron County, separated from Socorro County in 1921, covers an area of 6,900 square miles at the western edge of the State between Socorro County and the State of Arizona. The county has a population of 3,315. Reserve, a town of 500 people, whose nearest rail connection is 85 miles away, is the county seat.

The surface rocks are chiefly Tertiary volcanic flows. The entire metal output of the county, with the exception of tin and a few tons of ore from the Wilcox area, has come from the Mogollon (Cooney) district.

BLACK RANGE (TAYLOR CREEK) TIN DISTRICT[2]

The Black Range tin deposits are scattered over an area of about 450 square miles on the west slope of the Black Range in southeastern Catron County and northwestern Sierra County. Claims were first located in 1919 on Taylor and Squaw Creeks, and in 1920 on Hardcastle Creek.

The tin occurs as cassiterite in veinlets in soft, kaolinized rhyolite, and as local disseminations in the walls. The cassiterite is chiefly the dense botryoidal variety, but red tabular crystals intimately mixed with specularite also occur. The veins are small and not persistent. The rhyolite, which is the oldest rock in the district, is overlain by tuff, breccia, and thin basalt flows; sandstone and conglomerate; and sand and gravel. Much of the stream gravels of the district carries placer tin derived from the veins.

As part of the strategic-minerals program in 1939, the U. S. Bureau of Mines sampled the more promising lode and placer occurrences of tin in the district. Some of the deposits were resampled by the Bureau in 1942 and 1943. No appreciable tonnage of commercial-grade tin-bearing lode or placer material was revealed by the exploration. According to Fries (1940, p 355), the stringers are too small to be mined separately, and the deposits would have to be mined by bulk methods. In the areas sampled no sizable deposit has been found that contains as much as 1 pound of tin per ton. Placer deposits have been found only in the vicinity of bedrock deposits. The best placer deposit sampled contains about 4,000 cubic yards of gravel that averages about 2 pounds of tin per cubic yard. The gravel in the other deposits sampled averages less than 0.05 pound, and a large part of it averages less than 0.005 pound.

The total output from the area has been small. The production between 1940 and 1943 was estimated by the U. S. Bureau of Mines to be

2. Hill (1922); Fries (1940); Volin et al. (1947).

around 11 tons of concentrates, with an average assay of close to 50 percent tin. This was the most active period in the district.

MOGOLLON (COONEY) DISTRICT

The Mogollon (Cooney) district is in the southwest part of Catron County and is about 85 miles northwest of Silver City, the nearest railhead. It is located in the Mogollon Mountains, near the western border of the State.

The first claims were located in 1875 by James Cooney. Owing to Indian troubles no ore was shipped until 1879, after which date mining activity increased rapidly in the district. Production, which is valued at about 25 million dollars, has been almost entirely in gold and silver. The district has been a very important contributor to the State's output of these metals since 1880. During the period 1904-1942 the district accounted for 40 percent of all the silver and 25 percent of all the gold produced in New Mexico.

Production prior to 1904 had a value of approximately $5 million, and from 1904 to 1930 it amounted to $14,633,923. The district reached its maximum importance in 1913, when it produced gold, silver, and subordinate amounts of copper and lead valued at $1,409,912.

The early production in the district came primarily from the Cooney, Little Fanny, Last Chance, and Maud S veins. Since 1904 practically all production has come from the Little Fanny, Last Chance, and Champion mines. Production declined rapidly after 1917; late in 1925 the district was shut down almost completely.

A revival of mining occurred in 1931, when Ira L. Wright and associates, of Silver City, New Mexico, known as the Wright Leasing Co., began operations on the Little Fanny and Johnson group of claims. In 1933 the Black Hawk Consolidated Mines Co. took over the Wright Leasing Co. and continued production until 1942, when the Government order restricting the operation of gold mines caused an almost total shutdown of the district. In the period October 1931 to June 1942 the Wright Leasing Co. and the Black Hawk Consolidated Mines Co. produced 513,255 tons of gold and silver ore valued at approximately $5 million.[3] Most of the ore mined during this period came from the Queen vein. Although this is the main vein of the district, very little ore was mined from it prior to 1933.

In 1935 the Mogollon Consolidated Mines Co. reopened the Deadwood-Last Chance group and built a 150-ton flotation mill to treat the ore. The mill operated until 1937.

In February 1943 the Silver Creek Mining Co. leased the Bearup group of claims located north of Silver City, 3 miles west of Mogollon. During the years 1943 to April 1947, this company produced 5,862 tons of ore containing 3,329 ounces of gold and 210,316 ounces of silver (Minerals Yearbooks, 1943-1947).

3. W. J. Weatherby, Mogollon, New Mexico; personal communication, 1948.

During the years 1947-1949 exploration work was done in the district by several companies, especially by the Bradley Mining Co., of San Francisco, and an exploration company also financed by California investors. Both of these exploratory efforts were aimed at possible extensions of ore bodies in the Queen vein. No ore of commercial value was discovered in either of these efforts.

Prior to the introduction of cyanidation as a treatment for gold ores in 1905, stamp milling followed by gravity concentration and amalgamation was the method used for recovering values from all ores in the district. Recoveries in these early operations were reported to have been only 50-70 percent of the total value of the ores. After 1905 cyanidation or gravity concentration followed by cyanidation has been the chief method of treatment. This method improved recoveries to as much as 90 percent of the crude-ore values.

Ore treated prior to 1905 probably contained $20 or more of gold and silver per ton. In the period 1905-1926 ores valued at $10-$15 per ton were mined. Ores treated by the Wright Leasing Co. and the Black Hawk Co. in more recent operations are reported to have averaged 0.14 ounce of gold and 6.94 ounces of silver per ton.[4]

The ore deposits of the Mogollon district are in fault veins in the Tertiary volcanic rocks, consisting of rhyolite, quartz latite, andesite, and accompanying pyroclastic rocks. The region is crisscrossed by faults which follow two main directions, one a little east of north and the other a little north of west, and which have broken the area into irregular blocks. With the exception of a large, recent fault on the western mountain front, every important fault shows some mineralization. Most of the veins have prominent outcrops. The productive area is less than 2 miles long by 1 mile wide and lies west of the town of Mogollon.

The ore occurs in shoots, commonly from 300 to 600 feet in drift length and about the same along the dip, and usually from 5 to 15 feet wide. Most of the deposits show sharp changes from ore containing 8 ounces or more of silver to low-grade material carrying 3 ounces of silver or less. In the average ore of the district the ratio of silver to gold is about 50 to 1.

Quartz and calcite are the chief gangue minerals. Fluorite is also present. The most abundant metallic minerals are pyrite, chalcopyrite, galena, sphalerite, bornite, argentite, stromeyerite, and chalcocite. The ores show fine colloform texture.

CHAVES COUNTY

Chaves County, located in the southeastern quarter of the State has an area of 6,094 square miles and a population of 39,884 (1950). Roswell is the county seat.

This county is practically devoid of known metal resources. Placer

4. W. J. Weatherby, Mogollon, New Mexico; personal communication, 1948.

TABLE 2. PRODUCTION OF METALS IN THE MOGOLLON (COONEY) DISTRICT, CATRON COUNTY, 1880-1954

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Total Value
Prior to 1904	-	-	-	-	$ 5,000,000*
1904-1930	$5,662,409	13,306,141	944,601	14,687	14,633,923
1931	14,967	38,800	1,100	-	26,319
1932	66,441	136,869	1,000	400	105,113
1933	54,817	126,020	3,000	400	99,131
1934	111,790	121,357	4,300	1,000	190,624
1935	243,116	274,172	1,000	1,000	440,300
1936	282,576	364,816	5,000	1,000	565,632
1937	264,558	310,450	1,800	-	504.909
1938	313,614	429,847	500		591,544
1939	269,780	381,013	900	-	528,501
1940	341,635	547,020	1,700	300	730,834
1941	275,940	489,943	600	-	624,415
1942	116,445	210,243	1,700	200	266,170
1943	26,060	47,368	1,200	-	58,900
1944	37,415	61,349	1,000		81,176
1945	49,525	91,786	-	-	114,495
1946	11,165	18,187		-	25,860
1947	2,275	3,938			5,839
1948-1954†	-	-		-	-
Totals	$8,143,528	16,959,319	969,401	18,987	$24,593,685

* Gold and silver; estimated.
† No production.

gold is reported to occur along the Rio Hondo (Schrader et al., 1917, p 214), presumably derived from the deposits of Lincoln County, which adjoins Chaves County on the west. No metal production has ever been reported from the county.

COLFAX COUNTY

Colfax County, in northeastern New Mexico, borders the State of Colorado. It contains 3,765 square miles and in 1950 had a population of 16,356. Raton, the largest town, is the county seat. The western boundary, separating Colfax from Taos County, lies along the crest of the Rocky Mountains, here known as the Sangre de Cristo Range. The rest of the county lies at the edge of the vast plateau that extends eastward from the foot of the range.

The main part of the Sangre de Cristo Range south of Elizabethtown is composed chiefly of Carboniferous strata, but north of this place Precambrian rocks predominate. East of the main mountains is the Cimarron Range, which attains its greatest elevation in Baldy Peak near Elizabethtown and extends north and south for about 30 miles. It is composed mainly of monzonite porphyry, which domes the overlying

sedimentary rocks. South of the monzonite are great basalt flows, which rest on Cretaceous strata. These strata extend across most of the remaining parts of the county. In the northeastern part the Cretaceous rocks locally are covered by remnants of basalt flows.

The metal-mining activities in Colfax County have been in the area of Baldy Peak or not far removed from it. The region has been essentially a producer of gold. The igneous intrusions of monzonite porphyry which penetrated the sedimentary rock produced two types of gold deposits; namely, quartz veins and contact metamorphic deposits in the calcareous sedimentary rocks. Placer gold derived from the primary gold deposits has been the source of much of the gold mined in the county.

Lode deposits, including the famous Aztec mine, were discovered in 1868. Within a few years the new area attained an estimated production of $1.2 million, principally from a pocket or bonanza struck in the Aztec mine in the early state of its development. The production of the county in the years from 1881 to 1912 was small. Between 1912 and 1920 there was considerable activity in the Elizabethtown district, the Aztec mine producing $1,680,718 and $245,079 in bullion and concentrates respectively. The output between 1920 and 1935 again was small, although the amalgamation and gravity-concentration plants installed on the property during earlier years continued to operate periodically on a reduced scale, and some placer operations were conducted. In 1935 a flotation plant was installed on the property of the Aztec mine. This mill continued to operate until 1940, during which period the production from Colfax County again rose to a value of over $100,000 per year. Since 1940 production has amounted to only a few thousand dollars each year.

Production in the county prior to 1904 was about $4.4 million, and the total production to 1948 approximated $10 million. Nearly all this output was lode and placer gold, of which about one-half was from lode deposits. Table 3 shows the combined lode and placer production of gold and silver from 1868 to 1945 (Pettit, unpublished report).

BALDY (UTE CREEK) DISTRICT5

This district lies to the east of Baldy Mountain in the valley of Ute Creek and on a high ridge to the south known as Black Horse Mountain. The district comprises the Aztec, Rebel Chief, Montezuma, Bull of the Woods, and Black Horse mines and some less important claims.

The Aztec mine has been by far the most important metal producer in Colfax County. The ore has come from veins parallel to the bedding in a quartzitic sandstone of lower Tertiary age, or from veins which followed the contact between the sandstone and underlying shale. In some instances large ore shoots extended into the sandstone or the shale. The total production of the Aztec mine is estimated to exceed 4 million

5. Pettit, unpublished report; Lee, 1916, pp 325-330; Chase and Muir, 1923, pp 270-281.

TABLE 3. PRODUCTION OF METALS IN COLFAX COUNTY, 1904-1954

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Total Value
1904-1914*	$ 360,464	3,597	24,060	2,470	$ 365,948
1915-1919	1,627,114	11,181	23,942	1,717	1,641,029
1920-1924	223,038	1,674	592	-	224,791
1925-1929	126,850	1,105	1,937	-	127,800
1930	248	-	-	-	248
1931-1932†	-	-	-	-	-
1933	7,176	83	-	-	7,205
1934	40,074	150	-	-	40,195
1935	81,091	292	-	-	81,633
1936	107,786	2,528	105,200	-	119,422
1937	126,331	2,724	11,200	800	145,915
1938	118,559	1,205	27,500	300	122,047
1939	98,000	1,196	28,500	-	101,776
1940	44,555	280	1,200	-	44,890
1941	24,605	97		-	24,674
1942	10,570	38	-	-	10,597
1943	770	3		-	772
1944	105	-		-	105
1945	175	4	-	-	178
1946	175	1		-	176
1947	385	6	-	-	390
1948-1954‡	-	-	-	-	-
Total	$2,998,071	26,164	224,131	5,287	$3,059,791*

* Production prior to 1904 is estimated at $4,400,000.

† Production not reported by counties in U.S.B.M. Minerals Yearbook.

‡ No production.

dollars. The property has remained idle since 1940, and most of the workings have caved in.

The Rebel Chief, Montezuma, Bull of the Woods, and Black Horse mines are located within about a mile of the Aztec mine, their discovery dating back to the early days of the district. Some high-grade ore has been taken from these mines, but the total output has been relatively small. In the aggregate, however, they probably have produced well over half a million dollars in gold, the Montezuma being the chief contributor.

Ute Creek was one of the important placer-mining sections in the Baldy Mountain area. In 1941 a large washing plant operated in Ute Creek for a short time. Mining operations were conducted to within a mile of the Aztec mill.

CIMARRONCITO DISTRICT

The Cimarroncito district is about 14 miles southeast of Elizabethtown and lies near the crest on the east side of the Cimarron Range. No extensive bodies of good ore have been found, and production has been slight.

The explored mineral deposits of the district consist almost wholly of contact-metamorphic deposits in limestone near masses of intrusive monzonite porphyry. Quartz veins in the intrusive rock have been developed at one or two places. The intruded sediments are Pennsylvanian and Cretaceous in age. The contact-metamorphic ores are typical of the general class and are characterized by andradite garnet, epidote, quartz, calcite, specularite, magnetite, chalcopyrite, and pyrite. The gold content is somewhat higher than is typical for ore of this class. Some ore contains up to $10 in gold and 3 or 4 ounces of silver to the ton, and as much as 8 to 10 percent of copper, but very little ore of such grade has been found.

ELIZABETHTOWN (MORENO) DISTRICT

This district comprises a narrow strip of country extending east and west across the Cimarron Range. It includes the town of Elizabethtown, 35 miles northeast of Taos. The district lies on the west slope of Baldy Mountain and is a western continuation of the Baldy district. The general geology of the two districts is essentially the same.

The rocks exposed in the Elizabethtown district consist of Upper Cretaceous sediments (chiefly Pierre shale) which have been faulted and later intruded by numerous dikes and sills of monzonite and quartz monzonite porphyries. The igneous rocks are part of the same general intrusion which is exposed in the Baldy and Cimarroncito districts, and which extends as far north as Costilla Peak (Darton, 1928-a).

The gold deposits are of three types: quartz veins, contact-metamorphic deposits, and placers. The veins occur both in the monzonite and at the contact of sills of monzonite with the shale, the contact apparently being the more common location. The veins are simple fissures and lodes in which several narrow, parallel veinlets constitute an individual ore body. The lodes are more common in the porphyry. The veins range from a fraction of an inch to a few inches in thickness, and may be traced up to a half mile in length. In composition they are essentially auriferous quartz-pyrite veins, although chalcopyrite and galena are present here and there in small amounts. Pyrrhotite is intergrown with pyrite in the shale. Oxidation is well advanced; as a result, a large part of the gold is free. Much of the recovered ore is said to have averaged $10-$20 a ton.

Contact-metamorphic deposits are less abundant and economically less important than the veins. The calcareous shales in contact with thick sills and stocks of porphyry are altered to dark crystalline rocks largely composed of diopside and scapolite and some epidote, calcite, amphibole, and magnetite. Pyrite, pyrrhotite, and chalcopyrite are intergrown with magnetite. The ores on the whole are of low grade.

The Red Bandanna, Empire, Moreno, Centennial, Galena, and American Flag claims comprise a group, now called the Red Bandanna,

which was worked intermittently from the time of their discovery in the 1880's until just before World War II. Although these claims lie in Grouse Gulch and probably contributed much to the rich placer gold found in this gulch, they have not been particularly important as lode claims. Prior to 1941 a cyanide mill, with a capacity of from 25 to 50 tons, was in operation on the Red Bandanna group. The mill operated for a time on Red Bandanna ore. When this ore proved too low grade for profitable treatment, ore from the Iron Mountains prospect in the southern part of the district was substituted.

The Chester claim lies high on the ridge that separates the headwaters of Big Negro Gulch from those of Pine Gulch. The mine has not been worked since 1881. An exploration tunnel started near the Chester workings was driven completely through Baldy Mountain. This work, which was completed in 1937, revealed many mineralized zones, but none of present commercial importance. North of the Chester claim, at the head of Pine Gulch, is the Golden Era group, which includes the War Eagle, Golden Era, Fairfax Twin, and City View claims. Some high-grade ore was produced from this group and treated in an arrastra in the adjoining Ute district. There have been no recent mining operations.

The Elizabethtown district is important chiefly for its output of placer gold. Rich placer gold was found in the district in 1866 by prospectors who were sent to do assessment work on claims upon which copper float had been found. The resulting boom lasted many years. Grouse Gulch and Humbug Gulch, west flowing tributaries of the Moreno River, each yielded over a million dollars in placer gold and silver. Another million dollars in placer gold and silver has been recovered from the valley of the Moreno River. To work the gravels of Grouse and Humbug Gulches, a 41-mile aqueduct was constructed to bring water from the headwaters of the Red River into the Moreno area. This aqueduct was built in 1868 at a cost of nearly a quarter of a million dollars. Referred to as the "Big Ditch," it served the district for many years. The bulk of the production was attained before 1881.

PONIL DISTRICT

This district lies north and northeast of Baldy Mountain. It includes the valley of South Ponil and Placer Creeks, and intervening ridges and spurs known as French Henry Mountain and North Baldy Ridge (Pettit, unpublished report).

A number of properties have been operated in this district, some since the earliest days of mining in the county, but the output from lode mines has been small. Several milling plants were installed, including a modern flotation plant placed on the French Henry mining property in 1938. Their operations were not successful.

Some placer mines were operated in this district, but they were not very productive.

WILLOW CREEK DISTRICT6

This district lies southeast of Baldy Mountain, in the drainage area of Willow Creek. It is bounded on the east and north by high ridges extending outward from Baldy Mountain, and on the west by the divide that separates Willow Creek drainage from Anniseta Gulch and other westward flowing tributaries of the Moreno River.

The district has not been an important producer of lode gold, but has contributed greatly to the output of placer gold from Colfax County. Approximately $1 million in gold and silver has come from the Willow Creek placers.

A copper property, the Mystic mine, has been worked intermittently for years, the most recent operation being in 1937 and 1938. Some high-grade copper ore was shipped from the mine.

CURRY COUNTY

Curry County, in the east central part of the State, is bounded on the east by the State of Texas. It lies within the Great Plains. It has an area of 1,403 square miles, and its population is 23,174 (1950). Clovis, the county seat, is the largest town.

No metallic resources have ever been reported from this county.

DE BACA COUNTY

De Baca County, located in east central New Mexico, has an area of 2,358 square miles. Its population in 1950 was 3,460. Ft. Sumner, the largest town, is the county seat.

This county has no recorded production of metallic ores. Although small low-grade gold placers were reported in the early days, no attempt has been made to prove or exploit them.

DONA ANA COUNTY

Dona Ana County occupies an area of 3,804 square miles in central southern New Mexico and has a population of 39,044 (1950). It is bordered by Mexico and the State of Texas on the south, Luna and Sierra Counties on the west, Sierra County on the north, and Otero County on the east. Las Cruces is the county seat. The Rio Grande flows diagonally across the county from northwest to southeast, and then out of the State into Texas.

Most of the county lies in the Rio Grande Valley. In the southwest part is a fairly large area of Quaternary basalt known as the West Potrillo Mountains. In the northwest part there is a similar area of Tertiary and Quaternary volcanic rocks known as the Sierra de las Uvas. These mountains are a short distance south of the southern end of the Sierra Caballos, which extends into Dona Ana County nearly

6. Pettit, unpublished report.

to Rincon. Near the eastern edge of the county a chain of mountain ranges extends, with but a single interruption, the full length of the county. This chain, from north to south, consists of the San Andres, Organ, and Franklin Mountains.

The San Andres Mountains, partly in Sierra County, extend from the north boundary of Dona Ana County to San Augustin Pass, a distance of 36 miles. The Organ Mountains continue from San Augustine Pass to Target Range Gap, approximately 18 miles. The Franklin Mountains continue from the Gap to El Paso, lying within Texas for the greater part of their length.

Almost the entire metal production of Dona Ana County has come from the Organ district, which comprises the northern part of the Organ Mountains and the extreme southern end of the San Andres Mountains. The first known mining in this area started in 1849. Although early records are not available, the production from the county from 1849 to 1948 is estimated to have been close to $2.5 million.

TABLE 4. PRODUCTION OF METALS IN DONA ANA COUNTY, 1904-1954

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total Value
19044914*	$ 7,938	138,510	1,473,340	5,011,146	30,000	$ 611,055
1915-1919	3,136	71,375	894,056	1,863,291	220,679	409,921
1920-1924	44	6,168	177,746	154,740	26,852	52,134
1925-1929	195	23,152	83,278	794,386	-	81,380
1930	3,113	1,587	17,000	11,000	-	6,484
1931-1932†	-	-	-	-	-	-
1933	332	2,060	3,000	80,000	-	4,069
1934	280	2,673	1,900	63,000	-	4,518
1935	-	736	-	200	-	537
1936	-	22	-	300	-	34
1937	245	477	800	7,900	-	1,175
1938	3,914	322	6,500	-	-	4,786
1939	2,450	392	2,800	4,600	-	3,233
1940	3,885	509	2,800	2,300	-	4,678
1941	-	97	-	12,000	12,000	1,653
1942	3,220	-	6,200	-	211,000	23,593
1943	-	938	15,000	5,000	363,000	42,196
1944	-	180	400	1,200	-	278
1945	-	-	-	-	-	-
1946	-	110	-	-	4,000	525
1947	70	1,792	1,100	51,000	-	9,267
1948	70	1,548	2,000	32,000	18,000	10,027
1949	-	201	28,000	4,000	40,000	11,290
1950	35	1,687	30,000	16,000	512,000	82,666
1951	175	1,306	10,000	6,000	256,000	51,407
1952	-	179	-	8,000	-	1,612
1953-1954‡	-	-	-	-	-	-
Totals	$29,102	256,021	2,755,920	8,128,063	1,693,531	$1,418,518

* Production prior to 1904 is estimated at $1,000,000.
† Production not reported by counties in U.S.B.M. Minerals Yearbook.
‡ No production.

BLACK MOUNTAIN-GOLD CAMP DISTRICT[7]

This district is in the southern end of the San Andres Mountains, several miles north of San Augustin Pass, and about 8-10 miles east-northeast of Organ. It is generally considered a part of the Organ district.

Small production is reported from this district. The Mountain Chief mine, located in 1883, is believed to have yielded $12,000 in gold. The high-grade ore, said to have been a mixture of limonite and coarse calcite with free gold, apparently was removed entirely by the original owner.

In Gold Camp the country rock is Precambrian granite. The ore occurs in narrow, sharply defined, quartz-filled veins, which strike eastward and dip steeply. The ore contains auriferous pyrite and subordinate chalcopyrite. Free gold occurs near the surface in a shallow zone of oxidation. Bismuth minerals are reported to occur with some of the ores.

In Black Mountain lower Paleozoic sedimentary rocks rest on a basement of Precambrian granite and schist. Along the steep southern face of the mountain the contact between Fusselman dolomite and Percha shale is well exposed. The known ore deposits occur in the dolomite below this contact.

HEMBRILLO-SAN ANDRECITO DISTRICT[8]

This district, not far from the Sierra-Dona Ana County line, includes San Andrecito, Deadman, Lostman, and Hembrillo Canyons and the east slope of the San Andres Mountains between the canyons. No accurate data on the production of this district are available. The Green Crawford mine in San Andrecito Canyon and the prospects in Hembrillo Canyon were developed during the closing years of the last century, and there may have been a small output of copper ore at that time. Some ore was shipped from the Green Crawford mine between 1920 and 1930. It is unlikely that the total production from the district exceeded $10,000.

Chalcocite is the principal ore mineral in Hembrillo Canyon; in the Green Crawford mine chalcopyrite, covellite, chalcocite, and cuprite have been noted.

ORGAN DISTRICT

The Organ district comprises that section of the Organ-San Pedro Range which extends from about 6 miles south of Organ to about 4 miles north of Organ.

The Organ Mountains consist mainly of a large intrusive mass of quartz monzonite. Precambrian granite overlain by westward dipping Paleozoic strata occurs at the north end of the mountains, and Missis-

7. Dunham (1935, pp 262-263).
8. Dunham (1935, pp 252-257).

sippian and Pennsylvanian limestones are exposed over a large area. An excellent account of the geology, mineral deposits, and mines of the Organ Mountains is given by Dunham (1935).

The ore deposits of the Organ district may be classified as follows: pegmatites, veins cutting the Tertiary batholith, veins cutting Precambrian rocks, deposits in the Torpedo-Bennett fault zone, and replacement deposits in limestones and dolomites.

Pegmatites

Three metal mines developed in the pegmatites are the Ben Nevis, the Gray Eagle, and the Quickstrike. To date these mines have not been important producers.

Veins Cutting the Tertiary Batholith

Deposits of this type are found at the Big Three, Dave King, Galloway, Poor Man's Friend, and Silver Coinage mines, the Crested Butte prospect, and the Hawkeye and Texas Canyon groups of claims. The ore deposits occur in mineral areas cutting the intrusive monzonites. Considerable prospecting has been done on veins of this type, but up to the present the production has not been large.

Veins in Precambrian Rocks

Mines in the Precambrian strata include those of the Black Hawk, Buck Deer, Dummy B, Eureka, Green Girl, Pagoda, Pharmacist, Rock of Ages, and Santa Cruz prospects, and the Dona Dora, Maggie G, Mormon, Sally, and Sunol mines.

The Mormon mine is the only one of this group from which there has been appreciable production. The largest mine is reported to have produced about $40,000 in gold between 1880 and 1910. From 1938 to 1941 the Mormon mine was operated on a small scale by the Donalco Mining Co. This company was liquidated in 1941.

Deposits Related to the Torpedo-Bennett Fault Zone

The greater part of the metal production from the Organ district, and therefore from the county, has come from mines located on or near the "Torpedo-Bennett" fault zone, the north-south trending fault system which extends along the west side of the Organ Mountains from Hardscrabble Hill to Dripping Springs.

The Stevenson-Bennett mine is the most productive mine in the fault zone. This mine has been worked on a large scale, and for a time a mill of 300 tons daily capacity was in operation at the deposit. Dunham (1935, p 221) estimates the total production from the time of discovery in 1847 to 1935 at around $1,200,000, mostly in silver and lead. There has been no appreciable production since 1920, although considerable development work was done on the property in 1940.

The Torpedo mine on the fault zone north of the Stevenson-Bennett mine was discovered in 1899 and has produced several hundred thou-

sand dollars in copper during several periods of operation since that time. There has been no recent production.

The Modoc property is located on a southward continuation of the Torpedo-Bennett fault zone. The production, estimated to be as high as $200,000, was almost entirely in lead. The period of activity was from 1879 to 1905.

A fourth mine, the Orejon, and a few prospects are also included in the class of deposits related to the Torpedo-Bennett fault zone.

Replacement Deposits in Limestones and Dolomites

The most important mine belonging to this class is the Memphis. The deposit was worked actively during a number of periods after its discovery in 1882, and produced, according to local estimates, over $200,000 in copper, zinc, and silver. No important work has been done on the property since 1929.

Other metal deposits occurring in metamorphosed limestone are those of the Excelsior and Merrimac mines. The Excelsior mine has produced a small amount of copper. The ore in the Merrimac deposit contains sphalerite and pyrite, with subordinate amounts of chalcopyrite and galena. During 1942 and 1943 ore from the Merrimac mine was shipped to the lead-zinc-copper custom mill of the American Smelting and Refining Co. at Hanover, and for a time the mine was under lease by that company. Ira L. Wright and Associates, of Silver City, operated the mine for several months in 1951, producing 25-50 tons of high-grade zinc ore per day. The ore was trucked to the American Smelting and Refining Co. mill at Deming. An expansion of the White Sands Proving Ground brought the property within that reservation, and mining was discontinued in June 1951.

Other deposits belonging to this classification, but which are replacements in limestones not previously metamorphosed, are found in the Little Buck, Rickardite, Hill Top, Black Prince, Homestake, Philadelphia, Smith Silver Jim, and Devil's Canyon mines. There have been no large producers from this group.

RINCON MANGANESE DISTRICT

The manganese deposits in the vicinity of Rincon occur in Tertiary sandstone and conglomerate in the southern foothills of the Caballos Range. The ore consists of manganese oxides, chiefly psilomelane, in a gangue of barite and calcite, and occurs along numerous fault fissures of small displacement and along minor parallel fractures. Recent sand and gravel deposits derived from the adjacent slopes occur south of the vein deposits; some of this detrital material contains considerable fragmental psilomelane.

Small shipments of manganese-bearing rock were made from this district during World War I and World War II.

The deposits were explored further in 1952 and 1953, and a small amount of ore was delivered to the Deming stockpile.

OTHER MINING DISTRICTS[9]

Some mining has been done for gold, silver, and the base metals in the Northern Franklin, Potrillo, and Dona Ana Mountains, and in San Andres and Bear Canyons in the San Andres Mountains. However, there has been no significant yield from these districts.

There are some bodies of hematite in the Iron Hill district, in the low hills west of Robledo Mountain, northwest of Las Cruces. Although a possible source of iron in the distant future, these deposits are too inaccessible for present exploitation.

EDDY COUNTY

Eddy County is in the southeastern part of the State, bordering Texas on the south and Lea County on the east. It has an area of 4,163 square miles and a population of 40,421 (1950). Carlsbad is the county seat. The Pecos River flows from north to south through the county, dividing it into almost equal parts. The western half of the county ranges from rolling foothill and plateau country to moderately rugged mountains in the extreme southwest, where the peaks of the Guadalupe Range attain an elevation of 8,000 feet. The eastern half is rolling desert country, with many sinks, dry lake beds, and large depressions caused by slumping of the subsurface formations over the huge salt beds.

The metallic resources of Eddy County, insofar as is known at the present time, are unimportant. The only deposits reported occur in the Chupadera limestones northwest of Carlsbad, where low-grade copper has been found, and in the Caprock escarpment just east of Artesia, where small amounts of lead, zinc, copper, gold, and silver have been found in a brecciated quartzite.

The only metal production reported from the county to date came from the copper deposits northwest of Carlsbad, which produced 500 pounds of copper and 3 ounces of silver in 1941, and 700 pounds of copper in 1947.

GRANT COUNTY

Grant County, in southwestern New Mexico and adjacent to the State of Arizona, has an area of 3,970 square miles and a population of 21,561 (1950). Silver City is the county seat. It is bounded by Catron County on the north, Sierra and Luna Counties on the east, and Luna and Hidalgo Counties on the south. Hidalgo County was a part of Grant County until July 1920. The boundary between Grant and Sierra Counties follows the crest of the Mimbres or Black Range, which may be said

9. Dunham (1935, pp 243-262).

to form the eastern margin of the Plateau province. In this region the general plateau character is due to thick Tertiary volcanic flows into which the Gila and Mimbres Rivers and their tributaries have cut deep valleys. In the region around Silver City, Pinos Altos, Santa Rita, and Hanover, erosion has exposed the underlying Cretaceous and Paleozoic sediments which are broken by faults and intruded by masses of quartz diorite and granodiorite porphyry. The Big Burro Mountains, an extensive mass of Precambrian rocks, rise out of the alluvium southwest of this area.

Grant County is by far the most important metal-producing county in New Mexico. Of the State's total metal production from 1880 to 1954, valued at about 900 million dollars, over 700 million dollars has come from Grant County. Production figures for the years 1904 to 1954 are given in Table 5.

In addition to silver, gold, copper, lead, and zinc, a large tonnage of iron ore and manganese ore has been mined. In recent years a considerable amount of molybdenum has been produced as a byproduct of the Chino copper deposit. Other metals occurring in the county are radium, uranium, vanadium, bismuth, cobalt, and nickel.

BLACK HAWK (ALHAMBRA, BULLARD'S PEAK) DISTRICT

The old camp of Black Hawk is in the northern part of the Burro Mountains, about 12 miles northwest of Tyrone and about 15 miles west of Silver City. Rich silver float is said to have been discovered here in 1881. The district was booming from 1885 to 1887. Mining continued up to 1893, but nothing of consequence has been done since that date. Production of the camp amounts to perhaps one million dollars (Lindgren et al., 1910, p 324).

The deposits of the district are veins in Precambrian gneiss, some of them parallel to or otherwise associated with dikes of diorite porphyry. The ore is said to have consisted of dolomite and barite associated with much native silver and argentite and a little horn silver. Nickel and cobalt occur with the silver ore (Hillebrand, 1889, p 46; Waller and Moses, 1892, p 49).

The veins are narrow and the metal content erratic. The principal vein has been opened to a vertical depth of almost 700 feet, and native silver is said to have been found at that depth.

The U. S. Government did some core drilling on this property in 1953, trying to locate cobalt-nickel ore of commercial grade and volume. Nothing of importance was found.

BURRO MOUNTAINS (TYRONE, COW SPRINGS) DISTRICT[10]

Copper was discovered in the Burro Mountains in 1871, and several periods of activity and idleness followed. Two smelters were erected, but

10. Paige (1911, pp 131-150; 1916, pp 15-17; 1922); Somers (1915, pp 604-644); Minerals Yearbooks.

TABLE 5. PRODUCTION OF NONFERROUS METALS, GRANT COUNTY, 1904-1954

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total Value
1904-1914*	$1,264,683	1,964,753	187,544,972	7,344,371	11,945,421	$ 31,489,607
1915-1919*	1,702,647	2,221,349	408,660,678	12,783,407	49,947,307	104,937,535
1920-1924	315,865	475,871	219,413,319	5,135,990	37,588,280	36,143,360
1924-1929	574,068	893,462	385,524,609	19,249,960	78,508,000	64,506,517
1930	79,300	413,379	57,604,600	8,047,500	30,783,000	9,607,008
1931	75,651	437,400	56,328,000	6,848,000	14,099,000	6,117,483
1932	45,551	480,370	26,527,000	7,056,800	10,241,000	2,371,152
1933	37,044	409,580	25,160,000	1,610,240	22,507,000	2,993,732
1934	106,565	362,572	21,826,600	5,829,100	18,218,000	3,086,134
1935	99,275	325,003	3,148,000	3,876,700	16,807,000	1,488,731
1936	67,550	444,475	4,451,300	5,418,000	21,436,000	2,142,344
1937	343,819	520,667	59,020,000	4,726,000	24,500,000	89,110,486
1938	306,768	307,426	33,161,400	825,400	33,421,000	5,397,501
1939	362,915	671,045	84,728,000	6,566,000	48,221,000	12,446,218
1940	548,660	716,376	130,050,000	7,188,000	60,157,000	19,903,024
1941	517,755	737,003	137,814,000	8,168,000	70,473,000	23,054,778
1942	204,890	298,323	152,837,000	7,134,000	86,086,000	27,394,284
1943	108,780	234,064	145,739,000	8,301,000	107,473,000	31,483,571
1944	99,750	268,307	133,814,000	10,383,000	92,197,000	29,696,534
1945	93,275	241,079	110,644,000	12,030,000	74,382,000	24,790,159
1946	66,885	145,932	97,707,000	6,885,000	65,179,000	24,715,635
1947	34,895	196,623	116,469,500	7,470,000	78,040,000	35,189,954
1948	52,150	249,047	145,640,000	8,620,000	72,884,000	43,117,982
1949	37,590	179,262	106,578,000	5,788,000	54,040,000	28,828,182
1950	80,395	201,075	127,406,000	5,138,000	74,648,000	35,216,472
1951	89,600	291,945	143,176,000	7,108,000	83,358,000	51,767,257
1952	61,460	337,916	148,088,000	9,676,000	97,280,000	53,910,903
1953	34,500	81,444	139,742,000	3,048,000	25,674,000	43,566,043
1954	24,770	27,723	122,448,000	296,000	14,000	36,481,823
Total	$7,437,056	14,133,471	3,531,250,978	202,550,468	1,460,107,008	$880,954,409

* Production from Hidalgo County included.

they were unsuccessful. Interest was revived in the region by important discoveries in 1902. In 1905 the Phelps Dodge Co. (now the Phelps Dodge Corp.) purchased the property of the Burro Mountain Copper Co. at Leopold and in 1912 acquired the property of the Chemung Copper Co. of Tyrone. The mines were developed for large-scale operations, and a concentrating mill with a capacity of 2,000 tons per day was constructed. The district reached its maximum importance in 1918, when it produced 17 million pounds of copper.

The Burro Mountains mine of the Phelps Dodge Corp. was shut down in March 1921. During the period from 1921 to 1929 the activity in the district consisted mainly of leaching operations conducted on the mine dumps and some small-scale leasing. In 1928 and 1929 a small leaching plant treated mixed oxide and sulfide ores. The Burro Mountains mine itself remained idle from 1921 to 1941, when the mine was prepared for underground leaching. From 1941 to 1950 inclusive the mine produced 30 million pounds of copper by this method, which consists of percolating water through the former mine workings and precipitating the dissolved copper from the return solutions. The method continued to be used until 1950.

Since 1950 the company has been doing extensive core drilling in the old mine area and adjacent country. It is reported that a large-scale open-pit operation is in the planning stage.

The Burro Mountains are made up of two distinct mountain masses separated by the Mangas Valley. The Little Burro Mountains are on the northeast side of the valley and north of Tyrone. They trend northwest along a tilted fault block that has been elevated on its west side by a strong northwest trending fault. The range consists of Precambrian granite and Cretaceous sediments intruded by andesitic and rhyolitic rocks and overlain by Tertiary volcanic flows.

The Big Burro Mountains are southwest of the valley and consist of a Precambrian granite complex intruded by a large mass of quartz monzonite porphyry. Part of the quartz monzonite mass is covered by Quaternary gravel, but the exposed part is about 5 miles long and 4 miles wide.

Three classes of ore deposits occur in the district: (1) quartz veins, (2) irregular sulfide-impregnated fracture zones in the Precambrian rock, and (3) secondarily enriched deposits of disseminated sulfides in highly fractured parts of the quartz monzonite and adjacent granite. Class 3 is by far the most important.

Quartz veins have been mined chiefly at the southeastern end of the Little Burro Mountains, about 1¾ miles north of Tyrone. These veins are simple, well-defined fissures in Precambrian granite. The ores contain pyrite, chalcopyrite, sphalerite, galena, and silver chloride. Manganese oxides are locally very abundant, and enrichment of gold and silver has been important in the upper parts of the veins. Silver and gold are the chief metals produced.

Iron and copper sulfides and gold occur in fairly well-defined fracture zones at a number of places within the Precambrian area. Bismuth minerals are present locally. The gold-bearing quartz-sulfide stringers have been surficially enriched, but the zone of oxidation is shallow.

The secondarily enriched copper deposits in monzonite and granite, which have yielded nearly all the copper produced, and to which the district owes its importance, are in the northeast foothills of the Big Burro Mountains. The quartz monzonite porphyry and the adjacent granite are intensely fractured in places. The area of fractured rock is roughly triangular, with the apex southwest of Leopold. The zone of greatest fracturing lies between Leopold and Tyrone and forms roughly the northwest side of the triangle. The primary ore was deposited in these fractures and in the wall rock between. Fracturing diminishes toward the south, and the richness of the disseminated ores likewise diminishes in this direction.

Sulfides have been leached from the ore-bearing rock near the surface, and much of this rock has been thoroughly cleansed of its copper. Leaching extends locally to depths of 700 feet or more and is deepest near strong veins and faults. An irregular chalcocite zone having a maximum thickness of 300 feet underlies the zone of oxidation and leaching. The chalcocite ore carries about 2-3 percent of copper. A number of unconnected ore bodies of this type were explored by churn drilling. They range in size from half a million to several million tons. Below the chalcocite zone is low-grade primary material (protore) carrying pyrite and very small amounts of chalcopyrite and sphalerite. A little molybdenite is also present.

The chalcocite ore also has been subjected to some oxidation and leaching. The present water level stands at 300-500 feet below the surface and shows no close relation to the zone of chalcocite enrichment. Chalcocite ore is found above and below the water level. The depth to which oxidation has penetrated the rocks increases northeastward from Leopold to Tyrone. At Tyrone the chalcocite zone lies at considerable depths, whereas at Leopold this zone is at some places 50 feet or less from the surface.

CAP ROCK MOUNTAIN MANGANESE DISTRICT

The Cap Rock Mountain district is about 20 miles north of Lordsburg, in the vicinity of Cap Rock Mountain. The manganese ore occurs as veins in quartzite and Gila conglomerate. It is largely psilomelane.

No production figures are available.

CARPENTER DISTRICT

See Swartz district, Grant County.

CENTRAL AREA

The Central Mining area (Spencer and Paige, 1935), in eastern Grant County, comprises the mining districts around the towns of Central,

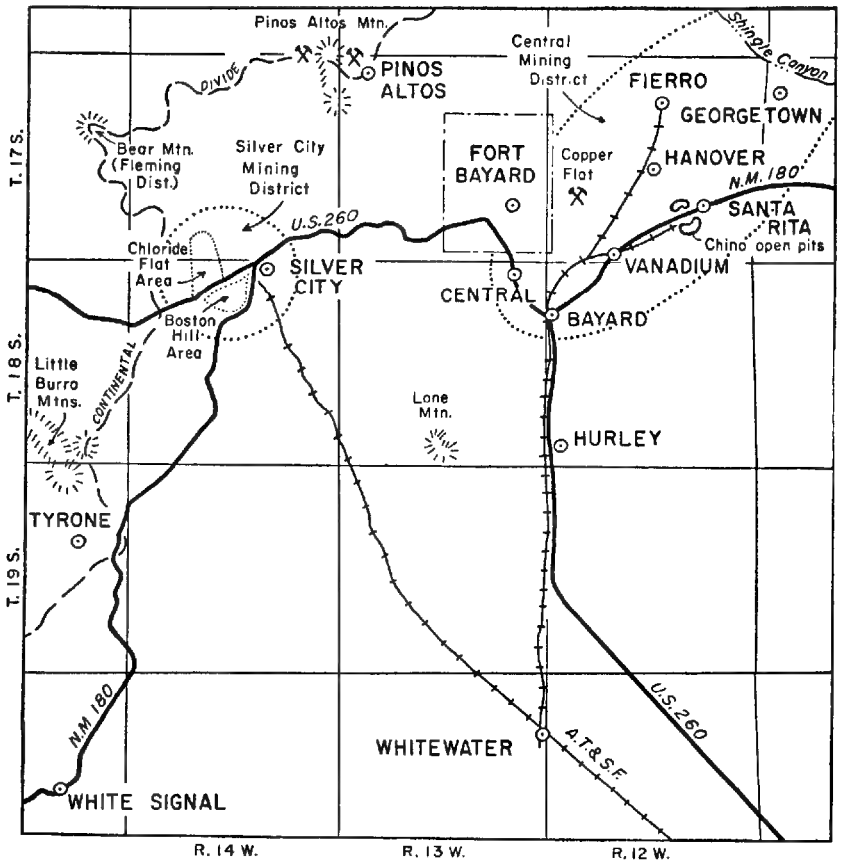

Fig. 1

GRANT COUNTY MINING AREAS.

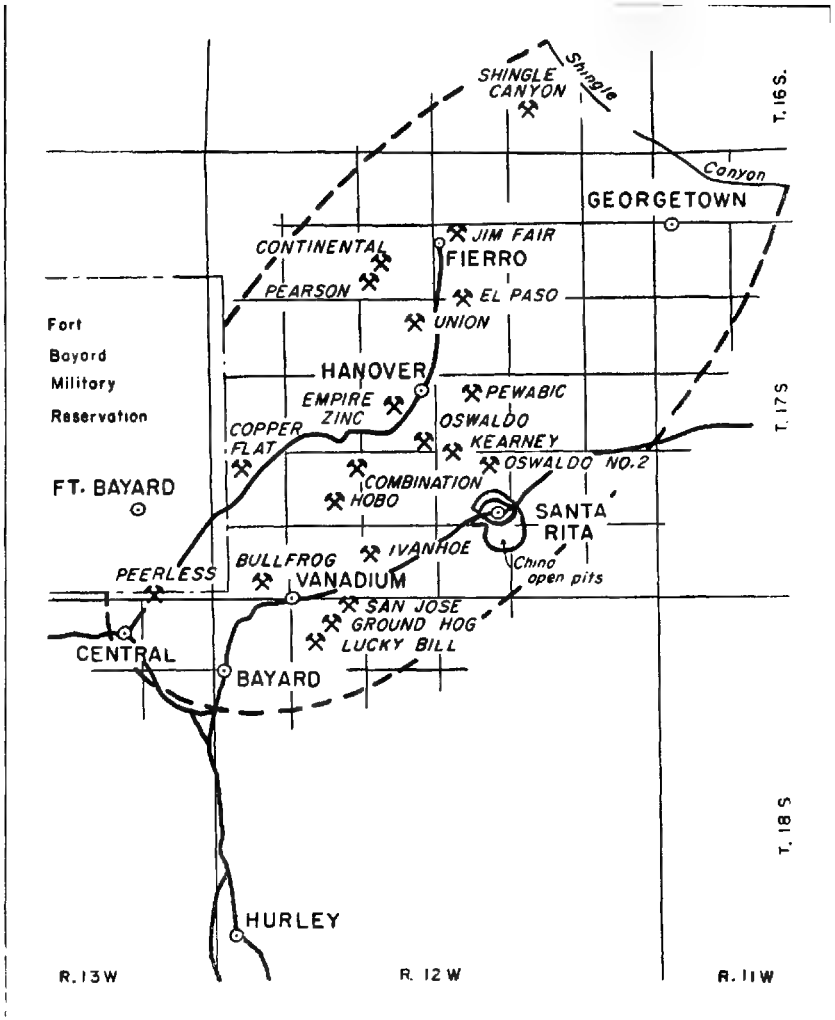

Fig. 2
CENTRAL MINING AREA.

Bayard, Fierro, Hanover, Georgetown, and Santa Rita. The location of the area is shown in Figure 2.

The Central area is well known both within and without the State of New Mexico, its productivity having exceeded that of all the other metal-mining districts in the State combined. It appears likely that the district will maintain this dominant position, its production continuing, possibly on an increased scale, for many years.

The geology and mining operations of the area are described by districts. Production statistics for the various districts, however, generally are combined. This procedure has been followed in Table 6, wherein statistics are given for the entire Central area for the years 1904-1954.

Hanover (-Fierro) District

General statement. The Hanover district[11] embraces the northern part of the Central area and includes the districts sometimes described separately as Hanover, Fierro, and Copper Flat. Iron and zinc have been the chief metals produced. Although copper ores are said to have been mined on a fairly large scale about the middle of the 19th century and possibly earlier, they have been of minor importance in recent times.

Large outcrops of magnetite attracted the attention of the early prospectors, and systematic mining of iron ore near Fierro began in 1891, when the Atchison, Topeka and Santa Fe Railway reached Hanover. During the early years the ore was used as flux by the smelters at El Paso, Texas, and Socorro, New Mexico. Ore shipments were made to the Colorado Fuel and Iron Co., at Pueblo, Colorado, about 1900, and mining was almost continuous from then until 1932. During this period approximately 4 million tons of iron ore was produced. Production of iron ore from the Hanover district since 1932 has been relatively small.

Deposits of oxidized zinc ore were mined in the vicinity of Hanover in the early 1890's. According to Blake (1895), shipments by rail from Hanover up to June 1894 amounted to 1,358 tons. Production remained small, however, until 1910. Zinc production from the Central area between 1904 and 1948 increased markedly.

In the years from 1904 to 1930 over 90 percent of the zinc produced in the Central area came from the Hanover district, chiefly from the mines of the New Jersey Zinc Co. After 1930 several other large companies began mining in the Hanover area: The Peru Mining Co. and its subsidiary, the New Mexico Consolidated Mining Co.; the Black Hawk Consolidated Mines Co.; the Kennecott Copper Corp.; and the United States Smelting Refining and Mining Co. After 1930, mines of the Bayard area, described later, also contributed substantially to the total zinc production of the Central area.

The sedimentary rocks in the vicinity of Hanover and Fierro are intruded and domed up by a large stock of granodiorite known as

11. Blake (1895, pp 187-195); Mullen and Storms (1948); Bacon and Joesting (1945).

Hanover-Fierro stock (see fig 3). The exposed part of the stock is about 2½ miles long, north to south, and about one mile wide. The sedimentary rocks consist of the Bliss sandstone (Cambrian), El Paso and Montoya limestones (Ordovician), Fusselman limestone (Silurian), Percha shale (Devonian), Lake Valley limestone (Mississippian), Magdalena limestone (Pennsylvanian), Abo formation (Permian), Beartooth quartzite (Upper Comanchean), and Colorado formation (Cretaceous). The sedimentary rocks are underlain by Precambrian rocks, chiefly granite and schist. A laccolithic sill of quartz diorite porphyry has intruded the Percha shale on the west flank of the dome, and other smaller sills occur at several horizons. These are earlier than the stock. The sedimentary and igneous rocks have been intruded by many granodiorite dikes and by postore Tertiary quartz latite dikes. The rocks are much faulted, the important faults trending northeast or north. Many of the dikes were intruded along fault fissures.

The sedimentary rocks surrounding the stock have been subjected to profound igneous metamorphism, and large replacement sulfide and iron-oxide ore bodies have been formed. The metamorphic zone is from a few hundred feet to several thousand feet wide. The contact silicates include garnet, hedenbergite, epidote, zoisite, diopside, wollastonite, serpentine, and ilvaite. The ore minerals include magnetite, specularite, pyrite, pyrrhotite, chalcopyrite, chalmersite, sphalerite, and galena. In general, the silicates were formed in the early stages of metamorphism and ore deposition, the iron oxides next, and the sulfides during the later stages. The limestones and dolomites of the sedimentary rocks were affected most, but some of the earlier dikes were also metamorphosed. The chief alteration minerals in the igneous rocks are zoisite, epidote, sericite, and quartz. Serpentine and wollastonite are confined largely to the lower Paleozoic dolomitic sediments, whereas garnet, epidote, ilvaite, and hedenbergite occur chiefly in the Lake Valley and Magdalena limestones. Magnetite and specularite as a rule occur adjacent to or within a short distance of the stock, and the sulfides at varying distances from it. Magnetite and sulfides are found in all the sedimentary rocks. Sphalerite is most abundant at distances of a few hundred to a thousand feet from the intrusion, but in places nearly pure sphalerite bodies have formed at greater distances. Galena is prominent here and there in the outer part of the sphalerite zone. Sphalerite and galena occur in the outermost zone of mineralization, and silver is moderately important. Silicification and recrystallization of the limestones have occurred in places, and the upper crinoidal member (Hanover limestone) of the Lake Valley limestone is coarsely crystalline in nearly all parts of the district.

In the Copper Flat subdistrict, limestone and shales of Mississippian and Pennsylvanian age were intruded by a quartz diorite laccolith during late Cretaceous time, and subsequently by a granodiorite porphyry stock during late Cretaceous or early Tertiary times. The sediments and the laccolith dip gently away from the stock.

The uppermost sedimentary formation in the Copper Flat district is the Pennsylvanian Middle Blue limestone (Magdalena formation), which is about 400 feet thick and consists of limestone with occasional shale partings. Conformably underlying the Pennsylvanian rocks is the Mississippian Hanover limestone (Lake Valley formation), of unknown thickness in the Copper Flat district.

Intruding both the sediments and the laccolith is the Copper Flat plug, a granodiorite porphyry stock of late Cretaceous or early Tertiary age. It is roughly circular in horizontal section, and its diameter decreases with depth. In places, near the present surface, the intrusion mushrooms into nearly flat, sill-like offshoots from the main stock.

Surrounding the stock is a prominent replacement zone in the Middle Blue limestone. Its width is greatest where the walls of the stock are deepest, and least where they are nearly flat.

Sphalerite and magnetite deposits, together with replacement silicates, are found in the replacement zone. Magnetite generally is associated with the sphalerite, but the reverse is not always true, because high-grade magnetite deposits containing no sphalerite have been found in the northwest part of the area. The deposits of economic size and grade occur in the wider parts of the replacement zone, adjacent to the steeper walls of the porphyry stock.

The Copper Flat laccolith has been little altered at its contact with the stock. Little is known concerning replacement of the underlying Hanover limestone, because of its relatively great depth. However, since the principal ore horizon in the nearby areas is in this formation, it is likely that deep drilling will encounter metalliferous deposits analogous to those in the shallower Middle Blue limestone.

Iron ore deposits. The iron ore deposits[12] of the Central area are arranged about the periphery of the Hanover-Fierro stock at or near the contact of the stock with sedimentary beds. The principal production of ore has come from the Union (Republic) mine, on the western edge of the intrusion, about midway between Hanover and Fierro, and the Jim Fair mine, at the northern end of the granodiorite mass, just above Fierro. Much of the recent (World War II) production, amounting, however, to a relatively small tonnage, came from the El Paso claim at the eastern contact between the granodiorite and the sedimentary rocks, and from an isolated deposit lying about a mile southeast of the southern end of the intrusive mass, near the Kearney zinc mine.

The iron ores consist largely of magnetite and subordinate specularite. Some bodies of nearly pure magnetite have been mined. Chalmersite, pyrite, chalcopyrite, sphalerite, and molybdenite are present locally in minor amounts. The magnetite ore normally contains about 0.6 percent copper, and at many places secondary ores of copper, representing copper leached from the primary magnetite bodies, lie between the iron ore and the igneous rock. An average partial analysis of con-

12. Paige (1908, pp 199-214); Spencer and Paige (1935, p 10); Minerals Yearbooks.

centrates obtained from ore mined near the surface is as follows: iron, 51 percent; phosphorus, 0.058 percent; silica, 7.28 percent; manganese, 0.72 percent; alumina, 1.42 percent; lime, 1.41 percent; magnesia, 13.38 percent; copper, 0.37 percent; sulfur, 0.38 percent. The magnesia presumably represents the original magnesia content of the dolomitic sedimentary rocks.

The production of iron ore, according to information supplied by the U. S. Bureau of Mines, includes 44,500 long tons mined by the Hanover Bessemer Iron Association and its successor, the Hanover Bessemer Iron and Copper Co., in the period 1896-1931. Part of the ore was run through a magnetic cobbing plant at Fierro, which raised the iron content about 10 percent. Since 1919 the Hanover Iron and Copper Co. properties have been a part of the U. S. Smelting Refining and Mining Co. holdings.

The iron mines were inactive from 1931 to 1941 except for a period during 1936 and 1937, when a small tonnage (30,000 tons of ore averaging above 56 percent iron) was mined and shipped.

During the war years 1942-1945 the St. Louis Smelting and Refining Co. produced about 150,000 tons of iron ore from the El Paso claim and the deposit near the Kearney mine, leased from the Kennecott Copper Corp.

There is a small deposit of manganese-iron ore located about 2 miles northeast of Fierro. The ore, which consists of manganite, wad, limonite, and a little manganiferous calcite, occurs along a fissure and as replacement bodies in the Fierro limestone. Only a small amount of ore has been exposed.

Empire Zinc Company operations. The Empire Zinc Co.,[13] a subsidiary of the New Jersey Zinc Co., has been an important producer of zinc ore in New Mexico for many years. The mines at Hanover have been in nearly continuous operation since 1902 except for several periods when the demand for zinc was low. Most of the earlier mined ore was probably zinc carbonate ore, and important amounts of zinc carbonate were mined until 1918. An electromagnetic mill was built in 1916 and continued in operation on sulfide ore until 1927, when it was replaced by a flotation mill. In 1920 the Empire Zinc Co. increased its holdings in the immediate vicinity of Hanover by the purchase of the Republic mine and the Welch group of 90 acres, adjoining their other property south of Hanover. From 1902 to 1931 the mines of the Empire Zinc Co. at Hanover are credited with an output of 500,000 tons of sphalerite ore, having an average content of 15 percent zinc, in addition to considerable amounts of high-grade carbonate ore produced in the earlier years.

In the years from April 1931 to June 1937 the mines were closed, but after reopening they remained in operation until September 1948.

13. Spencer and Paige (1935); Minerals Yearbooks.

Production from these mines in the period between June 1937 and January 1, 1948, was approximately 250 million pounds of zinc and about 4 million pounds of lead. The ores have been treated in the company-owned 300-ton flotation mill near Hanover. During the last few years the production of the company's Hanover mines has been appreciably curtailed, and the mill has treated a large tonnage of custom ore, mostly from the Oswaldo mine in the Hanover area, owned by the Kennecott Copper Corp., and the Kelly mine at Magdalena, owned by the Empire Zinc Co., which was operated by lessees.

The ores of the Empire Zinc Co. lie south and west of the Hanover-Fierro intrusive mass, within a zone of intensive alteration that adjoins the intrusion (see fig 3). The typical ore bodies occur in the upper part of the Lake Valley limestone and are confined largely to a massive limestone member about 120 feet thick, locally known as the "white crinoidal limestone." The deposits are typical replacement deposits in limestone.

The ore occurs in tabular, veinlike, podlike, and pipelike bodies. It consists of massive sphalerite, associated with which are small amounts of pyrite, chalcopyrite, and galena. Garnet, epidote, and particularly hedenbergite are characteristic gangue minerals. Commonly, the ore occurs adjacent to bodies of massive garnet or along dike contacts.

In the last few years much of the ore taken from the Hanover mines of the Empire Zinc Co. has come from an open-pit mine. All production of zinc ores was discontinued in 1953 because of a price decline that made it unprofitable to operate the mines.

Peru Mining Company operation. In 1927 the Peru Mining Co.,[14] a subsidiary of the Illinois Zinc Co., acquired the holdings of the Hanover Copper Co., about a half mile east from the town of Hanover. The holdings, which consisted of about 25 claims, have been known as the Pewabic group. For the most part, the ore mined has been lead-free zinc sulfide occurring in pod-shaped bodies and in areas along vertical channels in highly metamorphosed limestone lying close to and east of the massive granodiorite intrusion. Large bodies averaging 10 percent zinc have been mined.

A 100-ton selective flotation mill to treat the Pewabic ore and do custom milling was constructed early in 1928 at Wemple, 3½ miles northwest of Deming. The capacity of the mill was increased to 300 tons in the following year. In 1935 the mill capacity was rated at 500 tons of ore daily; by 1945 this had been increased to 1,000 tons.

Since it was taken over by the Peru Mining Co. in 1928, the Pewabic mine has been one of the most important zinc producers in the State of New Mexico. The production is estimated at around 300 million pounds of zinc, valued at $20-25 million. For the most part, zinc has been the only metal produced.

14. Mullen and Storms (1948); Minerals Yearbooks.

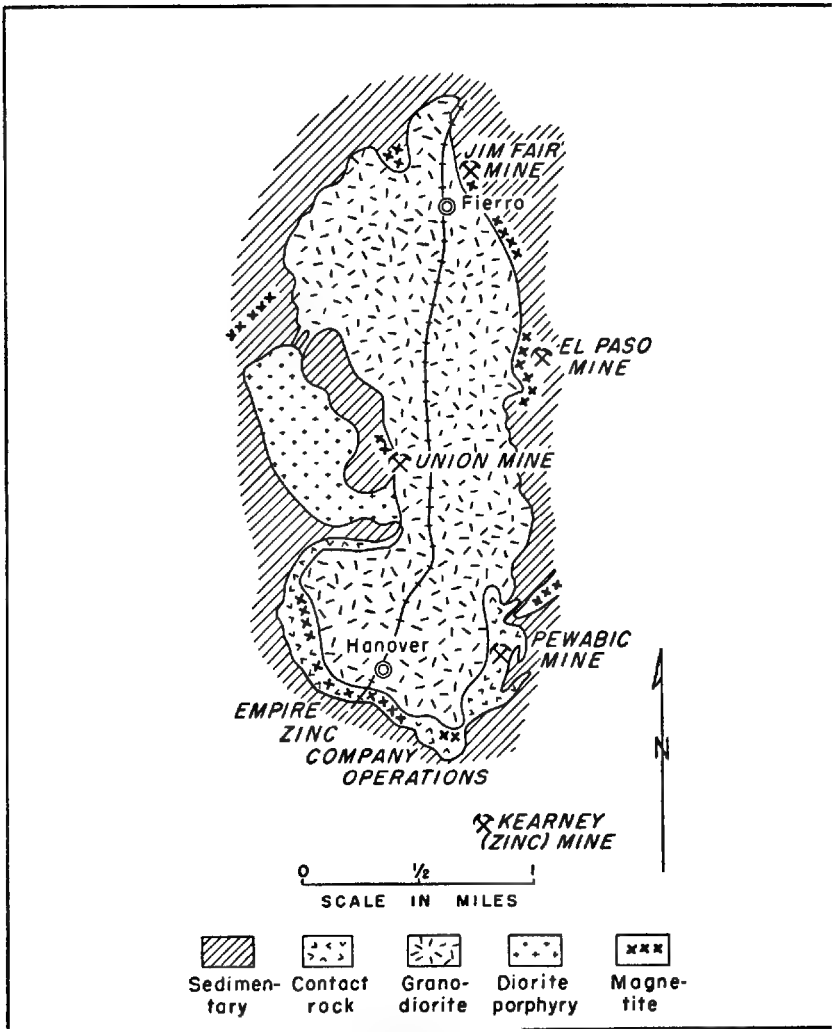

Fig. 3

HANOVER-FIERRO STOCK.

The New Mexico Consolidated Mining Co., a subsidiary of the Peru Mining Co., holds a number of claims in the Copper Flat area, a region located about 2½ miles west-southwest of the town of Hanover and about 4 miles northeast of Central. This group of claims has been worked through the Copper Flat mine.

The Copper Flat subdistrict first was prospected for copper about 1900. According to a local resident, the Calumet and Arizona Co. sank most of the shafts at that time. Later a small tonnage of iron ore was mined from surface deposits. The Empire Zinc Co. held the claims under lease for a number of years. After acquiring the property, the New Mexico Consolidated Mining Co. carried on extensive exploration and development work and began production of zinc ore in 1942.

During the early years of World War II, the New Mexico Consolidated Mining Co. also developed the Kearney mine located about a mile southeast of the town of Hanover, close to the Oswaldo mine. Ore from the Copper Flat and Kearney mines was treated at the Wemple mill near Deming. Operation of the Copper Flat mine continued until May 1947, and the Kearney mine was still producing in 1948. The combined production of the two mines from 1942 through 1947 was between 40 and 50 million pounds of zinc and between 2 and 3 million pounds of lead, with a combined value of around $5 million.

All operations were discontinued in 1953 because of a decline in the prices for lead and zinc.

Black Hawk Consolidated Mines Company (Hanover unit). The Black Hawk Consolidated Mines Co. (Minerals Yearbooks) was incorporated in 1919. The property owned by the company consisted of the Lucky Bill claim in the Bayard district and the Combination-Hobo group of claims located midway between the towns of Vanadium and Hanover. For the history of the Lucky Bill claim and the record of its production, see page 61.

In the period from 1925 to 1928 a moderate amount of ore was developed in the Hobo and Combination mines. In 1928, the Black Hawk Consolidated Mines Co. built a flotation mill to handle both this ore and custom ore from other mines in the district. In the 10-year period 1928-1938, the mill treated approximately 600,000 tons of ore and produced as concentrates around 100 million pounds of zinc, 40 million pounds of lead, 25 million pounds of copper, and 2.5 million ounces of silver. The bulk of the feed to the mill was custom ore from the Ground Hog and San Jose mines of the American Smelting and Refining Co. in the Bayard area. However, the Black Hawk mill also treated a considerable tonnage of ore from its own Combination-Hobo mines.

The American Smelting and Refining Co. began operating the Black Hawk mill under lease in 1938. Several years later the capacity of the mill was increased from 200 to 400 tons daily. From 1938 to 1946, the lessee treated as custom ore approximately 130,000 tons of ore from the

Combination and Hobo mines. It is estimated that about 25 million pounds of zinc and 5 million pounds of lead were produced from the Combination-Hobo group in this 8-year period.

The United States Smelting Refining and Mining Co. purchased the Combination-Hobo property from the Black Hawk Consolidated Mines Co. in 1946. Development work was performed in 1947, and in February 1948 the Hobo and Combination mines were producing close to 200 tons of ore daily.

These properties have not been worked since 1953.

Kennecott Copper Corporation (zinc property).[15] In 1942 the Kennecott Copper Corp. began development of its Oswaldo zinc property located about a mile southeast of Hanover and northwest of the Santa Rita open pits, near the boundary of the company's property. Some zinc-lead ore was treated in the Empire Zinc Co. mill at Hanover in 1944 and 1945. In 1946 Kennecott became the fourth largest producer of zinc in the State, and in 1947 it ranked second, with a combined production for the two years of around 30 million pounds of zinc. Operations were on two levels connected to the surface with a shaft 500 feet deep. Practically all the ore was mined from simple open stopes, as the ground stands well in open chambers.

In 1948 Kennecott was producing zinc ore at a rate of from 200 to 250 tons daily. The ore in August 1948 averaged about 15 percent zinc, and was treated in the Empire Zinc Co. mill.

Considerable exploration was carried out at this property, and some exploration work was done on the Ivanhoe property southwest of the Oswaldo and near the western end of the company property. Both properties were closed down in 1953.

The United States Smelting Refining and Mining Company mines.[16] In 1919 the U. S. Smelting Refining and Mining Co. acquired controlling interest in the property of the Hanover-Bessemer Iron and Copper Co., covering an area from Hanover to a point north of Fierro. Most of the claims lie west and north of the Hanover-Fierro stock. A description of the geology of this region is given on page 59. The company produced iron ore until 1931. Since World War II, as during the war period, this property has been operated as the Hanover-Bessemer section of the U. S. Smelting Refining and Mining Co., producing complex ore containing gold, silver, copper, lead, and zinc. The chief mines have been the Pearson and the Continental.

In 1946 the U. S. Smelting Refining and Mining Company purchased the Combination and Hobo mines from the Black Hawk Consolidated Mining Co. and began exploration and development. These mines became part of the Bull Frog section, which includes the company's mines

15. Minerals Yearbooks and unpublished reports.
16. Duriez and Neuman (1948); Minerals Yearbooks.

in the Bayard area. In 1948 the Combination and Hobo mines were contributing substantially to the production of the company.

A third area held by the company is known as Shingle Canyon. This area, acquired in recent years, is east and northeast of Fierro. Some production of complex ore containing gold, silver, copper, lead, and zinc came from the Shingle Canyon mines during the war years and in 1946 and 1947.

The ore bodies on the properties of the U. S. Smelting Refining and Mining Co. occur along a northeast striking fault system. The faults within the system are strong and normal and have vertical throws of as much as 1,000-2,000 feet. Granodiorite porphyry dikes, locally termed "bird's-eye" dikes, have been injected into this ore-bearing fault system. Ore bodies of two types are recognized. The first consists of lenses that occur along faults. In this type, ore shoots may be over 1,000 feet in maximum length and up to 25 feet in width (4-6 feet average), and generally occur where the faults cut through one of the thick quartz diorite sills that intrude the Cretaceous Colorado shale. The second type of commercial deposit consists of replacement of favorable limestone horizons adjacent to the fissures and granodiorite porphyry dikes. This type of deposit is usually 10-100 feet thick and 25-100 feet wide, and may occur along the dike or fissure for 1,000 feet or more.

The Mississippian Hanover limestone is the most favorable horizon for replacement ore bodies; other favorable horizons occur in the upper Magdalena limestone (Pennsylvanian), where it has been intruded by quartz diorite sills. The contacts at the top and bottom of the sills generally show the strongest mineralization.

In the Central area most of the mining is done underground. Vein-type ore bodies are stoped by shrink, shrink-fill, or cut-and-fill methods, depending upon the conditions of the ground. Replacement-type ore bodies in the limestone are mined with conventional room-andpillar methods.

The mines of the U. S. Smelting Refining and Mining Company are discussed further in connection with the Bayard district.

Bayard District

General statement. The Bayard district (Lasky, 1936), in the southern part of the Central area, includes the towns of Central, Vanadium, and Bayard (sometimes referred to as Bayard Junction). There are a number of important mines in this area, from which gold and silver, copper, lead, and zinc have been recovered. Mines operated by two large companies, the American Smelting and Refining Co. and the United States Smelting Refining and Mining Co., have accounted for most of the metal output. During World War II the Peerless mine, operated by the New Mexico Ore Processing Co., also contributed substantially to the production of the area.

The American Smelting and Refining Company mines.[17] The San Jose and the Ground Hog, the most extensively worked mines in the Bayard district, have been operated by the Asarco Mining Co., a subsidiary of the American Smelting and Refining Co., since 1928. The workings of the two mines are on the same vein, located a half mile southeast of the town of Vanadium. The San Jose mine was worked profitably for gold, silver, and copper prior to 1869 (Raymond, 1870, p 404). After that time it was worked sporadically, producing chiefly argentiferous lead, carbonate ore, and a little high-grade galena ore. The San Jose mine was taken over by the American Smelting and Refining Co. in 1928.

The Ground Hog claim, adjoining the San Jose claim, was located in 1900. Records indicate that there was very little metal mined prior to 1914. From 1914 until 1928, when it was taken over by the American Smelting and Refining Co., this mine produced close to $1 million in silver, lead, and copper.

Since 1928 the San Jose and Ground Hog mines have been operated as a unit, production in the period 1928 to 1947 inclusive amounting to around $35 million in silver, lead, copper, and zinc. During most of these years the production was divided rather evenly between the two mines. In 1947, however, the total production from the unit came from the Ground Hog mine. From the standpoint of tonnage, zinc, which was first produced in 1928, has been the important metal mined.

For the last 10 years the ores have been milled in a 200- to 400-ton differential flotation mill leased from the Black Hawk Consolidated Mining Co. (See Hanover-Fierro district.) Prior to 1938 the ores were treated as custom ore in the same mill. During 1948 the American Smelting and Refining Co. was sinking a 2,000-foot four-compartment shaft in preparation for mining the reserves discovered by diamond drilling. The 1947 operations were principally between the 1,200- and 1,800-foot levels of the mine. Square-set stoping and filling has been the mining method practiced by this company at the Ground Hog mine.

The Ground Hog deposit is situated in a saddle underlain by quartz diorite. Dikes of granodiorite porphyry cut the quartz diorite. The saddle is bounded on the east and west by Tertiary rhyolite, and by gravels and tuffs that are later than the ore. The ore occurs along a wide, gently dipping fault zone parallel to a general northeast trending fault system that is characteristic of the district. One large vein and a number of smaller parallel veins in the fault zone have been developed. Other veins occur in the adjacent quartz diorite.

The ore is chiefly in the dikes of quartz diorite, but locally granodiorite forms one or both of the walls. The Colorado shale-sandstone series is present at places in the fault zone near the veins. Adjacent to the vein the quartz diorite is silicified, sericitized, and pyritized, and generally altered beyond recognition. The granodiorite, however, at most places is comparatively fresh.

17. Lasky (1936); Minerals Yearbooks.

The primary ore consists of a massive intergrowth of sphalerite, chalcopyrite, and galena. The galena is argentiferous. Pyrite is common in the ore, and the nonsulfide gangue is chiefly quartz.

The Lucky Bill claim was located in 1900, the same year in which the Ground Hog claim was discovered. It adjoins the latter on the southwest, and its workings are located on the same vein system as those of the Ground Hog and San Jose mines. In the period from 1906 to 1932 the production from the Lucky Bill was $1,370,000. The ore produced was chiefly argentiferous lead carbonate. In 1911 some lead vanadate occurring with the oxidized lead ore was mined and shipped from this deposit.

The United States Smelting Refining and Mining Company operations. The United States Smelting Refining and Mining Company (Duriez and Neuman, 1948; Brough and Gillaspie, 1948) has holdings covering a belt roughly 1 mile wide by 10 miles long, extending throughout the length of the Bayard and Hanover districts, from the village of Bayard on the south to a point 3 miles northeast of the town of Fierro. Although the greater part of the holdings is in the Hanover area, the bulk of the production has come from the Bullfrog mine in the Bayard area. The Bullfrog mine is located about 1 mile northwest of the Ground Hog workings of the American Smelting and Refining Co.

The Bullfrog, first known as the Owl mine, was worked on a small scale prior to 1905. It was idle from 1905 until taken over, along with other nearby prospects, by the U. S. Smelting Refining and Mining Co. in 1940. After a period of exploration this company began mining the blocked-out ore in March 1943.

The ore is milled in a 600-ton differential mill originally built as a 250-ton concentrator. This plant, located on company property, has been in operation since production began in March 1943.

Zinc and lead have been the chief metals produced, with minor amounts of copper, silver, and gold. The company was the leading producer of zinc in the State during the years 1944, 1945, and 1946; and the leading producer of lead in 1945, 1946, and 1947. The zinc production from 1943 to 1947 amounted to over 100 million pounds, and the lead production for the same period was around 17 million pounds. The total metal production for 1943-1947 had a gross value of around $15 million. A small part of this production came from the mines operated by the company in the Hanover area.

These properties have all been idle since the middle of 1953.

Peerless mine. The Peerless mine (Soule, 1947) is one-fourth mile east of the town of Central. It adjoins the southern boundary of the Fort Bayard Military Reservation.

The early history of the mine is unrecorded. A few shallow stopes and shafts indicate a small amount of work, probably done in search of gold ore.

The first notable mining of these deposits was done by the Peerless Mining and Milling Co. in 1937 and 1938. The New Mexico Ore Processing Co. leased the property in 1943 and operated it until October 1945, by which time all known ore bodies were exhausted. The company began shipping ore to the Black Hawk mill at Hanover early in 1943, later purchasing a mill in Silver City. Ore was shipped to Silver City from April 1944 to February 1945, when this mill was closed, and the ore again was shipped to the Black Hawk mill.

The U. S. Bureau of Mines explored deeper parts of the Peerless vein in 1946. No new ore bodies were found, but zinc mineralization was noted in a favorable horizon about 1,800 feet below the surface.

Prior to 1943 the production of the Peerless mine amounted to 4,000 tons of ore containing 102 ounces of gold, 12,000 ounces of silver, 32,000 pounds of copper, 806,000 pounds of lead, and 1,012,000 pounds of zinc. The production by the New Mexico Ore Processing Co. from 1943 to 1945 inclusive was 20,918 tons of ore containing 518 ounces of gold, 32,698 ounces of silver, 58,000 pounds of copper, 3,514,000 pounds of lead, and 5,384,000 pounds of zinc.

A quartz diorite porphyry sill about 400 feet thick constitutes the surface rock in the area around the Peerless mine. Underlying the sill in the following downward sequence are about 360 feet of sandstone and shale of Upper Cretaceous age; about 110 feet of Beartooth quartzite and shales, also Upper Cretaceous; 580 feet of limestone and shale of Permian age; and the Lake Valley series of limestones of Mississippian age.

Santa Rita District[18]

The Santa Rita district is in eastern Grant County. The town of Santa Rita, about 12 miles east-northeast of Silver City, is near the center of the district. It is the terminus of a branch line of the Atchison, Topeka and Santa Fe Railway leaving the Deming-Silver City branch at Whitewater. The Santa Rita district adjoins the Hanover district of the Central area on the north and west and the Bayard district of the Central area on the west.

The only copper mining of importance in the United States antedating operations at Santa Rita was at the native copper deposits of northern Michigan. Mining at Santa Rita by the Spaniards began in 1801, the copper being shipped to Chihuahua and Mexico City under contract to supply metal for Mexican coinage. Production during this early period is said to have amounted to 4 million pounds of copper annually. It has been estimated that production up to 1904 amounted to 80 million pounds. From 1904 to 1909, when the Santa Rita mines were purchased by the Chino Copper Co., annual production averaged 3½

18. Paige (1916, pp 16-17); Spencer and Paige (1935); Luther (1946); Benjovsky (1947); Minerals Yearbooks.

million pounds of copper. The output dropped during the next 2 years, presumably because of preparations for steam shovel operations. These were started late in 1910, and the first ore was milled a year later. Operations were continuous from 1911 to October 1934, when they were suspended because of the adverse market conditions prevailing at that time. Resumed in January 1937, operations have continued since that date.

Production from 1911 to 1934 amounted to about 1 billion, 15 million pounds of copper valued at approximately $190 million. From 1937 to 1954 the copper production amounted to over 1 billion, 972 million pounds. In addition, some gold and silver was produced, and a v ery appreciable amount of molybdenite.

The Santa Rita mines now are owned by the Kennecott Copper Corp., which in 1933 acquired all the assets of the Nevada Consolidated Copper Co. and organized a wholly owned subsidiary, the Nevada Consolidated Corp., to operate the property. The Chino Copper Co., which purchased the Santa Rita mines in 1909 and began steam shovel operations in 1910, was taken over by the Ray Consolidated Copper Co. The latter was taken over in turn by the Nevada Consolidated Copper Company in 1926.

The mines of Santa Rita occupy an extensive area in which large bodies of low-grade ore occur. The average grade of ore mined in 1911 and 1912 was somewhat over 2 percent. This had decreased to around 1.5 percent by 1925, and in 1947 and 1948 the average grade of ore mined was less than 1 percent. Much development work has been done underground, but open-pit methods have been used to mine the great tonnage of ore that has been removed since 1911. Large tonnages of waste material have had to be removed. A new stripping program begun in 1947 and completed in 1952 made available for pit mining a very large tonnage of ore just east and southeast of the then operated pit. Also plans were being made to move the town and camp of Santa Rita from "the island" in the present pit to a site some distance north. This would make available the large ore reserves contained in "the island." In recent years much copper has been recovered by leaching the waste dump with a weak acid solution.

The milling plant, built at Hurley in 1910, had a daily capacity of 5,000 tons. The capacity has more than quadrupled since that time, and an average of about 20,000 tons of ore was treated daily during the war years 1942-1945 inclusive.

Prior to 1938 the concentrate was hauled to El Paso for smelting. A company-owned smelter, erected at Hurley in 1938 and the early part of 1939, began operating in May 1939. Later a fire-refining section was installed and placed in operation in May 1942. Since that date most of the copper has been in the form of fire-refined products. A new reverberatory furnace was added in 1950.

Production of molybdenum concentrates began late in 1937, and a considerable amount of molybdenite has been recovered each year since

then. Molybdenite is recovered as a byproduct in the concentration of the copper ores.

Although no definite figures have been published, it is known that very large ore reserves remain at Santa Rita, and mining can be expected to continue for many years.

Santa Rita lies in a well-defined basin formed by a local widening of Santa Rita Valley. The rim of the basin is highest at Santa Rita Mountain, which has an elevation of 7,365 feet, about 1,600 feet above Santa Rita Creek. The mountain rises along a steep erosional escarpment 400 to 1,200 feet high and is cut by many steep gulches and canyons. A continuation of the escarpment forms the eastern rim of the basin. The remainder of the basin rim was formed originally by a series of hills rising 100 to 450 feet above the basin floor, but some of these hills have been removed, wholly or in part, by steam shovels.

The rocks that crop out in the Santa Rita district consist of Pennsylvanian, Permian, Cretaceous, and Tertiary sedimentary rocks, Cretaceous intrusive porphyries, and Tertiary lavas and tuffs. The Pennsylvanian rocks are underlain by older Paleozoic and Precambrian rocks, which crop out to the north and east of the district.

The Pennsylvanian strata belong to the Magdalena formation and consist of limestone and shale in nearly equal amounts. The Magdalena formation, called the Upper Fierro limestone in earlier reports, ranges in thickness from about 600 to 825 feet in the vicinity of Santa Rita. A series of red beds, consisting chiefly of shales, crops out at several places in the district and has been correlated tentatively with the Abo formation of Permian age. It is definitely absent at most places, and its maximum thickness is about 200 feet. The Cretaceous sedimentary rocks are divided into the Comanchean Beartooth quartzite and the Benton (Lower Colorado) formation. The Beartooth quartzite consists chiefly of massive vitreous quartzite, but also contains sandstone and shale. It is 40-135 feet thick. The Benton formation rests upon the Beartooth quartzite. It forms the present erosion surface over a large part of the district; its full thickness is, therefore, not present. The maximum thickness exposed is about 585 feet. The formation consists essentially of sandstone and shale and includes a few limestone and calcareous layers. Shale predominates in the lower 175-225 feet of the formation. The Tertiary sedimentary rocks of the district consist of accumulations of tuffaceous gravels and sands interlain with volcanic tuffs. They were deposited upon an uneven erosion surface of Cretaceous and other rocks and are as much as 400 feet thick in places.

The intrusive rocks at Santa Rita include sills, stocks, and dikes. Most of the intrusives were injected probably in late Cretaceous time, but there are a few postore Tertiary dikes. The earliest intrusions were of quartz diorite porphyry and occur as sills and sill-like sheets. The largest of these is a great sill-like mass near the base of the Colorado formation, which contains numerous engulfed blocks and lenses of the

sedimentary rocks. It is nearly 1,500 feet thick in places, but this apparently great thickness is in part due to faulting. Smaller sills occur at the other horizons in the Colorado formation and in the underlying rocks; some of them are remarkably persistent.

The sedimentary rocks and the sills were intruded and domed by a large granodiorite porphyry stock, but the doming effect as a rule extends less than 1,000 feet from the stock. Satellitic dikes extend beyond the stock to the northwest and southeast, and a northeast trending system of granodiorite porphyry dikes cuts all the pre-Tertiary rocks of the district.

Extensive erosion followed the period of intrusive activity and uncovered the intrusive rocks at several places. The Tertiary sedimentary rocks were deposited on the resulting surface. Explosive volcanic activity was current at this time and added considerable fragmental volcanic material to the sediments. Upon the Tertiary sediments was deposited a thick series of flow rocks, which now form the main mass of Santa Rita Mountain. Rhyolite is dominant in the lower part of the series, but andesite prevails near the top. Several discontinuous layers of tuff are included in the flow series. The Tertiary rocks occur now only in the southern part of the district, though they doubtless covered all the area at some time.

The Santa Rita region is traversed by a complex network of faults. A northeast system is particularly prominent, but there are also a number of faults that strike in other directions. Faulting was operative over a considerable period of time, but the displacements are moderate as a rule. The earlier faults were intruded by some of the granodiorite dikes; the later ones have displaced the thick volcanic flows.

Igneous metamorphism of some of the sedimentary rocks is locally profound near the stock, but as a general feature of the district is less pronounced than later hydrothermal alteration. Igneous metamorphism is present also in some of the older igneous rocks. Adjacent to the granodiorite stock and to some of the dikes, the Magdalena limestone has been replaced by great volumes of iron oxides, garnet, epidote, chlorite, and other silicates. The Colorado formation has been changed to a compact porcelainlike rock. Silicification and sericitization are pronounced features of all the rocks in the district and are particularly intense in the mineralized area. Large volumes of rock, both igneous and sedimentary, are so thoroughly changed that their identification is difficult or impossible.

Primary mineralization for the most part followed the intrusion of the granodiorite dikes. Three types of deposits were formed: (1) contact-metamorphic deposits, (2) vein deposits, and (3) disseminated deposits in porphyry. The contact-metamorphic deposits are of little economic importance and are mined only as encountered in the course of steam shovel operations on the disseminated ore. At and very near the surface of some of these deposits, where the sulfides have been completely oxi-

dized, the remaining magnetite and hematite constitute potential iron ores. The vein deposits lie outside the immediate vicinity of Santa Rita and are discussed under the Central area. They generally consist of mixed sulfides in a quartz gangue.

The Santa Rita district owes its importance to the low-grade "disseminated porphyry" copper deposits. Primary mineralization of these deposits consisted of abundant pyrite, subordinate chalcopyrite, and meager amounts of magnetite, specularite, molybdenite, pyrrhotite, and sphalerite. The minerals were deposited along an intricate network of fractures and also were disseminated in the rock between the fractures. Most of the copper ore occurs in the granodiorite porphyry stock, but the quartz diorite south of the stock and the sedimentary rocks of the contact zone also are mineralized. Mineralization is more pronounced in the Magdalena limestone than in the other sedimentary rocks.

The material now mined as ore owes most of its value to secondary chalcocite enrichment. Chalcocite is the chief mineral of the sulfide ore. It occurs as disseminated particles, as larger solid masses, and as small seams and stringers. Enrichment has shown a general preference for chalcopyrite over pyrite. The chalcocite zone extends for many hundred feet below the water table along major faults and other rock contacts where supergene circulation has been vigorous. Bodies of impervious rock practically free of enrichment have been found at several places adjacent to or over these deeper enriched zones. The Santa Rita ores contain much less silver and gold than is usual in ores of this type.

The thickness of the overlying oxidized zone is erratic. Here and there, in strongly fractured areas, tongues of oxidized ore extend several hundred feet below the water level. Elsewhere the bottom of the oxidized zone lies some distance above this level. In general, copper carbonates and chrysocolla are most abundant in the upper part of the oxidized zone, cuprite in the middle part, and native copper in the lower part. Native copper and copper oxides are exceptionally abundant, particularly along the more pronounced fractures. Native copper constituted a larger proportion of the ore at Santa Rita than at any of the other large similar deposits of the Southwest. The overlap of oxidized and chalcocite zones in which native copper and chalcocite are both abundant extends through a vertical distance of 100 feet or more.

The leached zone above the ore bodies is variable in thickness but generally shallow. It is absent in the northern part of the area but is about 150 feet thick in the southern part. It is usually much thicker in the igneous than in the sedimentary rocks and may extend to relatively great depths along strong fracture zones.

The ore body has not yet been completely delimited. In the main part it is at least 600 feet thick, but ore has been cut in some of the drill holes at depths of 1,000 to 1,600 feet. As at present known, the ore body forms a horseshoe-shaped mass around the granodiorite stock, with a few isolated bodies at the open northwest side of the horseshoe. The width

of the horseshoe band is irregular; it is 1,000 feet on the northeast, 2,000 feet on the southeast, 1,200 feet on the southwest, and 400 feet on the northwest.

The leached zone over the ore is too small to have furnished the enriching copper for the secondary ores. It is supposed by some that this copper came from overlying disseminated and probable contact deposits stripped away prior to the extrusion of the Tertiary lavas.

The ore of the Santa Rita deposits is somewhat richer than the disseminated ore in several other districts in the Southwest. As in all deposits of this class, the line between ore and waste is an economic one controlled by the price of the metal and the cost of production.

FLEMING (BEAR MOUNTAIN) DISTRICT

Fleming Camp (Paige, 1916, pp 14-15) is about 5 miles northwest of Silver City. Most of the mining at this place occurred in the eighties and early nineties. Total production probably amounts to about $300,000.

The ore is reported to have occurred in many irregular pockets in the Beartooth (Cretaceous) quartzite, which at Fleming Camp overlies the Fusselman (Silurian) limestone. The silver, which was the important metal, was in the form of silver chloride, native silver, and argentite.

This district has not been active in recent years.

GEORGETOWN (MIMBRES) DISTRICT

The Georgetown district (Paige, 1916, p 14) is about 3 miles east of Fierro and just west of the Mimbres River. Silver was discovered here in 1866. The camp was booming in 1875, but mining was stopped with the fall in the price of silver in the early 1890's. The principal mines were the Naiad Queen, Commercial, and MacGregor, all owned by the Mimbres Mining Co. Ore of grade too low to be shipped was treated in a concentrating mill. The early production is estimated to have had a value of about $3½ million.

The ore mined occurred in the Fusselman limestone directly below the Percha shale and along and near dikes. The limestone is much silicified and is vuggy in places. The ore was pockety, and the stopes as a result are irregular in shape and direction. The ore was oxidized silver ore, which was valuable chiefly for its cerargyrite content, but it contained some native silver and argentite. Argentiferous galena was mined in small amounts. Other minerals reported include cerussite, bromyrite, pyrargyrite, and vanadinite.

There has been very little mining activity in this district, and practically no production, since the nineties.

GOLD HILL DISTRICT

The Gold Hill district is about 16 miles northeast of Lordsburg, in the large area of Precambrian rocks south of the Big Burro Mountains. Gold is said to have been discovered in this district in 1884. Two stamp

TABLE 6.
PRODUCTION OF METALS - CENTRAL AREA (BAYARD, HANOVER, AND SANTA RITA DISTRICTS), GRANT COUNTY, 1904-1953

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Molybdenum (pounds)	Total Value
1904-1930	$1,558,691	1,882,866	1,142,372,443	43,109,659	188,907,338	-	$215,466,222
1931-1932*	-	-	-	-	-	-	-
1933	41,759	414,711	25,000,142	6,000,816	22,000,440	-	2,973,573
1934	37,121	318,910	21,000,790	5,692,500	18,000,218	-	2,983,814
1935	80,932	286,097	3,094,650	3,781,150	16,807,000	-	1,362,306
1936	6,512	369,141	4,426,500	5,378,000	21,412,000	-	2,017,638
1937	120,433	303,483	58,928,800	4,562,200	23,773,000	125,537	9,382,831
1938	71,351	52,648	33,114,400	679,500	33,389,000	267,031	5,166,107
1939	169,015	420,769	84,687,500	5,881,300	47,354,000	1,273,769	12,892,595
1940	302,050	481,095	129,981,600	6,489,000	59,145,000	2,562,910	21,176,705
1941	241,255	476,138	135,454,500	7,804,600	69,297,000	2,254,044	23,738,360
1942	143,220	224,914	145,448,900	6,411,000	84,747,200	2,738,564	28,075,726
1943	95,795	181,264	141,256,000	7,142,200	104,431,500	2,014,302	31,812,252
1944	81,445	216,554	131,040,400	8,857,000	89,296,000	1,615,629	29,961,294
1945	56,315	204,127	110,394,200	10,757,300	72,489,600	910,998	25,003,819
1946	42,350	131,911	97,611,500	6,398,600	64,557,000	1,082,599	25,271,565
1947	27,020	167,538	114,142,900	6,889,900	76,309,800	805,508	34,923,468
1948	42,070	197,056	145,568,000	7,480,000	70,279,000	1,356,000	43,336,219
1949	30,415	136,483	106,958,000	4,958,000	52,751,000	712,000	28,832,291
195	70,245	151,480	127,388,000	4,629,500	53,793,500	1,378,000	35,619,486
1951	60,305	236,484	143,051,500	6,265,900	83,768,900	1,322,000	51,963,037
1952	47,405	306,236	148,016,000	8,971,000	96,086,000	1,367,000	54,326,243
1953	34,580	81,444	139,742,000	3,048,000	25,674,000	1,100,000	44,182,655
1954*	-	-	-	-	-	-	-
Totals	$3,360,284	7,241,349	3,188,678,725	171,187,125	1,374,268,496	22,885,891	$730,468,206

* Figures not available.

mills were erected and operated until the oxidized ores appeared to be mined out. Later cyanidation was used successfully.

The district has not been very active in recent years, although small ore shipments have been made occasionally.

The veins, which are believed to be of Precambrian age, are small, containing massive quartz and, at places, much pyrite and some galena. The ore is partly oxidized. Early mining in this district was of ores said to have run $15 to $40 a ton in gold.

According to E. H. Wells (private report) only a small amount of gold occurs in the northern part of the camp; the veins are mined for their silver content. The ore minerals are of argentiferous galena, pyrite, sphalerite, native silver, and cerussite. At most places in the sulfide zone the highest grade silver ore is associated with abundant galena and pyrite; in the oxidized zone it is associated with cerussite and limonite. Concentrates and ore, which netted about $43,000, were shipped from the northern part of the district in 1920 and 1921 by the Cooperative Mining Co.

No production has been reported for this district in recent years.

HACHITA (EUREKA) DISTRICT

This district is described under Hidalgo County.

LONE MOUNTAIN DISTRICT

Lone Mountain is an isolated group of three low hills about 6 miles southeast of Silver City. Rich silver ore is said to have been discovered in these hills in 1871. Some mining was done, and a mill was erected, but mining ceased after 2 or 3 years. Another silver deposit was discovered in 1920, and ore was shipped in 1921-1923 from this deposit. Lead was produced with the silver during these 3 years. After 1923 production from this district almost ceased. There has been no activity in recent years.

The ore lies chiefly in fractures in the Fusselman (Silurian) limestone. The most common ore mineral was silver chloride, and the richest ore also carried wire silver and argentite (?). The veins are narrow, and the metal content not persistent.

Manganiferous iron ore similar to that at Boston Hill occurs in the Lone Mountain district. A small amount of this ore was mined during World War I.

MALONE DISTRICT

Malone is about 13 miles nearly due southwest from Tyrone and near the Hidalgo County line. Most of the mining activities occurred in the latter part of the nineteenth century. The camp has been inactive for many years. Jones (1904, p 63) reports that placer mining was active in this district about 1884, prior to the discovery of lode deposits.

The ores (Leach, 1928, p 5) occur as quartz veins in Precambrian granite along and transverse to a fault contact between granite and Tertiary volcanic rocks. They contain gold and silver in the ratio of about 1 to 8. Lead and zinc sulfides were found in the veins below the gold and silver.

PINOS ALTOS DISTRICT[19]

The Pinos Altos district lies in the Pinos Altos Mountains, a small range extending about 5 miles in a north-south direction and about 3 miles wide. The district is 8 miles north-northeast of Silver City.

Placer gold was discovered on the east side of the Pinos Altos Mountains about 1860. Gold lodes were found shortly thereafter, and gold mines in the area were productive until the early part of the 20th century. Some mines of note in this early period were the Pacific, Mountain Key, Deep-Down-Atlantic, Silver Cell, Ohio, Kept Woman, Mogul, and Aztec.

Other than prospecting, little was done prior to 1910 on the western side of the mountain. A few tons of oxidized surface ores were shipped, and a small gold property was operated. The Empire Zinc Co. acquired the Cleveland mine in 1913, and from 1915 to 1919 the company mined about 125,000 tons of zinc-lead ore, treating it in a magnetic separation mill. This was the most productive period of the Pinos Altos district.

Production prior to 1904 is said to have amounted to about $4.7 million (Jones, 1904). From 1904 to 1929 the production 604,233 ounces of gold, 454,753 ounces of silver, 1,933,900 pounds of copper, 1,896,100 pounds a lead; and 17,961,900 pounds of zinc, valued at $3,228,600. From 1929 to 1947 inclusive the production was approximately 12,000 ounces of gold, 140,000 ounces of silver, 350,000 pounds of copper, 1,100,000 pounds of lead, and 5,700,000 pounds of zinc, valued at about $1.2 million.

Each year from 1932 to 1940 inclusive there were numerous small operations, both lode and placer, conducted in the district. The production, however, remained small, averaging around $50,000 total value per annum, with gold being the most important metal produced. Placer operations yielded about 18 percent of the total gold. During 1939, 1940, and 1941 dragline dredges operated in Bear Creek and Santo Domingo Gulch.

From 1941 to 1947 inclusive zinc was the most important metal mined in the Pinos Altos district. Most of this came from the Cleveland property. In 1941 and 1942 the production was largely from the retreatment of old tailings, and in 1943-1945 most of the production came from the mining of new ore. The Cleveland mine was not operated in 1947.

Other important producers in the last 15 years have been the Hazard, Silver Hill, Houston Thomas, and Sangston mines.

19. Soule (1948-b); Paige (1916, pp 14-17); Lindgren et al. (1910); Minerals Yearbooks.

The crest and eastern part of the Pinos Altos Mountains consist of igneous rocks, of which granodiorite, diorite, and diorite porphyry are the most prominent. These have penetrated part or all of the sedimentary rocks and tilted them at varying angles to the west. Rhyolite and other lavas later than the veins cover the intrusive rocks on the north.

The oldest rocks exposed on the western slopes are the Magdalena limestone of Pennsylvanian age. These are overlain by the Beartooth quartzite of Cretaceous age, which in turn underlies the Colorado sandstones and shales, also of Cretaceous age. The diorite intrusives occur as irregular dikes and sills and possibly as stocklike masses of varying size. The diorite underlies all known ore-bearing areas, but data are not available to show the nature of the intrusive mass.

Three classes of ore deposits occur in the district: (1) veins in the intrusive rock, (2) replacement bodies in the limestone, and (3) gold placer deposits. The veins form a northeast system which cuts both granodiorite and diorite porphyry masses. They are traceable for distances ranging from a few hundred to about 4,000 feet and die out at the ends by splitting into numerous branching veinlets. The average width is about 2½ feet. They are fissure fillings and contain chiefly pyrite, chalcopyrite, sphalerite, galena, gold, and silver in a quartz gangue. Native silver, argentite, and cerargyrite were the chief minerals of one important vein.

The replacement deposits in limestone are in the Magdalena limestone (Pennsylvanian). There are two important ore-bearing strata, 12 and 25 feet thick respectively, separated by 4-15 feet of limestone and cut by a number of dikes. The ore consists of an intimate intergrowth of sphalerite, galena, chalcopyrite, pyrite, and quartz, and is chiefly valuable for its zinc content. Extensive oxidized ore bodies have been mined near the surface.

The important placer deposits are gulch or creek placers along Bear Creek, Rich Gulch, and gulches near the old Gillette shaft. The gold is about 750 fine.

SILVER CITY DISTRICT

The Silver City district comprises the area within a short distance surrounding the town of Silver City, and includes the Chloride Flat and Boston Hill subdistricts. The town has long been known as the mining capital of New Mexico. Although the center of mining operations has shifted eastward to the Central area, the town of Silver City still retains its prestige as the most important metal-mining town in New Mexico.

Boston Hill Subdistrict

Boston Hill is a low hill which lies at the southeastern extremity of the Silver City range of mountains, and is just southwest of Silver

TABLE 7. PRODUCTION OF METALS IN THE PINOS ALTOS DISTRICT, GRANT COUNTY, 1932-1950

Year	Gold (ounces)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total Value
1932	654	3,280	13,100	13,400	-	$ 15,688
1933	551	4,755	18,000	57,000	67,000	19,118
1934	1,146	11,583	28,600	134,400	-	54,808
1935	2,026	14,258	37,450	94,400	-	88,052
1936	788	6,425	18,500	37,900	24,000	37,188
1937	777	10,157	33,200	94,900	672,000	88,347
1938	703	7,195	11,900	81,800	-	34,185
1939	974	11,107	15,700	119,700	147,000	56,532
1940	1,528	8,952	24,400	117,700	410,000	94,318
1941	1,169	4,683	10,500	62,100	1,089,000	130,699
1942	343	2,420	11,000	31,000	79,400	24,518
1943	99	19,188	72,800	81,400	1,337,000	177,075
1944	221	18,585	26,200	304,300	1,015,400	164,588
1945	92	10,426	14,400	116,000	595,200	91,002
1946	266	2,729	4,300	29,100	161,000	35,026
1947		-	-		-	-
1948	133	30,573	61,000	636,000	2,111,000	461,649
1949	94	5,588	15,000	186,000	486,000	101,226
1950	10	4,656	6,200	132,800	287,100	64,550
1951-1954*	-	-	-	-	-	-
Totals	11,574	176,560	422,250	2,329,900	8,481,100	$1,738,569

* No production reported.

City. The first mining in the area occurred in the early seventies. The similarity of the ores to some of those found in the neighboring silver districts of Chloride Flat and Fleming Camp, which were active at the time, led to considerable prospecting for silver, but very little of this metal was obtained. Copper was found in the southern part of the hill, but not in commercial quantities. The ore[20] was mined chiefly as manganiferous iron ore. A considerable quantity of fluxing ore was shipped to the smelters at El Paso, Texas, and Socorro, New Mexico, in the early nineties. Operations continued to supply the Silver City smelters until they finally closed in 1907.

The mining of manganiferous iron ore for use in the steel industry was commenced in 1916, when R. I. Kirchman and associates started work on the Legal Tender and Silver Spot groups on the eastern slope of Boston Hill. Numerous surface pits were worked over the entire Boston Hill mining district, and small tonnages of ore were removed at Chloride Flat. Except during 1921 mines were operated continuously from 1916 until 1931. A total of 409,145 long tons of manganiferous iron was shipped from 1916-1931 inclusive. The Colorado Fuel and Iron Co. operated the Silver Spot group under lease, churn-drilling part of the area during 1926 and 1927.

20. Entwistle (1944); Soule (1948-a); Minerals Yearbooks.

During 1937 manganiferous iron ores were again shipped to the Pueblo, Colorado, smelter of the Colorado Fuel and Iron Co. by the Luck Mining and Construction Co., which leased the Boston Hill group of claims. This group lies west of the Silver Spot and Legal Tender groups in the central and western part of Boston Hill. From 1939 to 1947 inclusive the Luck Mining and Construction Co. shipped a considerable tonnage of ore to the Pueblo smelter. Since 1937 all ore produced in the district has been mined by this company. The mine was active only a short time in 1954, because of curtailment of steel production. The open-pit and underground methods of mining have been employed.

Production of manganiferous iron ore at Boston Hill is given in Table 8.

Boston Hill consists of Lower Paleozoic sediments and Cretaceous shales cut off on the east by a large mass of quartz monzonite porphyry. A large fault separates the shale from the Paleozoic rocks. A banded felsitic intrusion occurs in places along the contact between the porphyry and the limestone and forms sills in the limestone. All the sedimentary rocks at Boston Hill, except those of Quaternary age, have been cut by sills and dikes. The Silurian and Ordovician dolomites are the host rocks for much of the manganiferous iron ore.

The principal ore minerals are hematite and pyrolusite, which in some places are closely intermingled. Small quantities of magnetite nearly always are present in the ores. Specularite, the micaceous variety of hematite, occurs throughout the Boston Hill area, but appears to be more abundant in the eastern and southeastern parts. Gangue minerals are quartz, calcite, dolomite, and barite.

Chloride Flat Subdistrict[21]

Chloride Flat is a narrow, shallow valley 1½ miles nearly due west of Silver City. Much of the early growth of Silver City was influenced by the discovery and mining of bonanza silver ore in this area.

The discovery of ore in Chloride Flat was made by John Bullard and others in the spring of 1870. The area was prosperous until 1893, when the price of silver dropped to 62 cents per ounce.

During the 23 years 1870-1893 much of the silver was smelted locally in crude adobe furnaces, and much silver bullion was marketed. Some silver was concentrated by the "patio process" and some by amalgamation in rotating barrels. At first the ore was crushed in arrastras, but soon several stamp mills were operating. At Breman's mill the crushed ore was mixed with salt and then roasted to produce silver chloride. At other mills silver chloride was dissolved in brine, and the metal precipitated with metallic copper.

On May 12, 1893, the Silver City, Deming and Pacific Railroad was completed to Silver City, thus simplifying the transportation of heavy

21. Entwistle (1944, pp 34-35); Paige (1916).

TABLE 8. PRODUCTION OF MANGANIFEROUS IRON ORE FROM BOSTON HILL, SILVER CITY DISTRICT, GRANT COUNTY, 1905-1954

Year	Long Tons	Grade	
		Mn (percent)	Fe (percent)
Before 1904	80,000 (est.)	(For flux at copper and lead smelters)	
1905-1906	none	-	-
1907	7,000	6	*
1908-1915	none	-	-
1916	16,574	10-35*	46
1917	15,590	10-35*	*
1918	32,832	10-35*	*
1919	12,198	10-35*	*
1920	19,259	10-35*	*
1921	none	-	-
1922	28,623	10-35*	*
1923	6,759	10-35*	*
1924	23,246	15	*
1925	40,848	13	*
1926	81,440	10-35*	*
1927	30,710	10-15	30-38
1928	19,081	10-25	*
1929	67,558	8	27
1930	14,427	9.75	26.4
1931-1936	none	-	-
1937	17,861	12	40
1938	5,113	12.7	41.2
1939	31,379	13	38
1940	36,835	13.2	*
1941	55,000 (est.)	13 (est.)	37 (est.)
1942	65,000 (est.)	13 (est.)	37 (est.)
1943	72,967	12	*
1944	100,683	12.7	*
1945	85,744	12	*
1946	72,799	12	*
1947	72,000	*	*
1948	71,000	*	*
1949	55,000	*	*
1950	60,000	*	*
1951	48,000	*	*
1952	42,000	*	*
1953	39,000	*	*
1954	8,200	*	*
Total	1,434,726		

* Grade of ore not available.

machinery. By the following year a smelter was in operation. Although the original intention to build a railroad from Silver City to Mogollon was never realized, a narrow-gauge line, called the Silver City, Pinos Altos and Mogollon Railroad, connected the smelter with Pinos Altos by way of Boston Hill and Chloride Flat. The rails were torn up finally in 1913.

By 1904 two smelters were operating in Silver City, and the demand

for limy ores to be used as flux in the smelting of copper and lead was great. Even with the low price of silver the mines at Chloride Flat could operate profitably because of the low treatment charges. While the mining of relatively low-grade silver ores was being pushed energetically, Manuel Taylor made two strikes of high-grade ore on the Grand Center claims at Chloride Flat. The first strike was in 1902 and the second in 1906. Although this good fortune encouraged more prospecting, no further high-grade deposits were found, and the Silver City smelters finally were closed in October 1907. The mining of silver ore continued at a reduced rate until 1914.

Some silver ore was mined at Chloride Flat from 1921 to 1923. The high lime content and the artificial price of silver set by the Pittman Act allowed mining of 10-ounce silver. During this period the Bohemian Mining Co., operating the Grand Center and Mary Belle claims, shipped approximately $75,000 worth of silver ore. A shipment of lead ore assaying 12 ounces of silver per ton and 16 percent lead was also made. When Government purchases of silver stopped on June 2, 1923, mining ceased.

Until 1934 Chloride Flat was idle, but after the subsidy of the silver mining industry by the Silver Purchase Proclamation (effective April 24, 1935) interest in the Chloride Flat mining district was renewed. The Cardinal Gold Mining Co. made a geologic examination at Chloride Flat, but no ore was mined. In 1937 the H. J. Byron interests, of New York, started exploration work on the "76" mine, and a few small shipments were made. Work in the area was largely discontinued when the artificial price was reduced on December 31, 1937, less than 100 tons of ore having been mined from 1938 to 1948 inclusive.

TABLE 9. ESTIMATED PRODUCTION OF SILVER ORE FROM CHLORIDE FLAT, 1870-1937

Year	Short Tons	Estimated Value
1870-1905	100,000	$3,000,000
1905-1914	30,000	200,000
1921-1923	18,000	85,000
1934-1937	1,000	8,000
Totals	149,000	$3,293,000

Chloride Flat is one of the few places in New Mexico where an excellent section of lower Paleozoic rocks is exposed. The Precambrian basement is overlain successively by Cambrian quartzite, Ordovician and Silurian limestones, Devonian shale, Carboniferous limestone, and Cretaceous quartzite and shale, all of which dip to the east. The strata are cut by porphyry dikes and sills.

The ore bodies are extremely irregular and occur mainly in the upper part of the Fusselman (Silurian) limestone, immediately beneath the Percha (Devonian) shale. Various oxidized lead and silver minerals, abundant pyrolusite, and some galena, magnetite, and limonite occur

in the ores. Silver chloride was the chief silver mineral mined; native silver and argentite (?) also were present in the ores. Lead was not an important constituent.

STEEPLE ROCK DISTRICT

The Steeple Rock district (Lindgren et al., 1910) is in western Grant County, 4 miles from the Arizona line. The nearest railroad point is the town of Duncan, Arizona, about 17 miles southwest.

The district has had two periods of major production. The first period began with the discovery of ore in the region about 1880 and ended with the closing of the Carlisle mine in 1897. The Carlisle was the most important producer in the district, the property having been worked vigorously for many years. Its production up to 1897 is reported to have been around $3 million.

After 1897 small lots of ore were shipped. In the period between 1910 and 1920, however, attempts were made to operate mines in the district in conjunction with concentrating plants. From 1920 to 1932 practically no ore was mined in the district. Production figures from 1897 to 1932 are not available, but the total production is believed to have been small.

The second period of productive activity began in 1932 and ended in 1947. In 1947 the district output was 203 ounces of gold, 3,765 ounces of silver, 33,700 pounds of copper, 193,000 pounds of lead, and 133,250 pounds of zinc, having a total value of $66,822. Annual production from 1932 to 1947 is shown in Table 10.

Most of this production resulted from activities of the East Camp Exploration Syndicate (name later changed to Exploration Syndicate, Inc.), which began producing ore from the East Camp group of claims in 1934. Gold and silver ores, containing some copper and lead, were mined from this group of claims until 1942. Until 1940 the ore was shipped to smelters, but from April 1940 to 1942 the ore was treated at the mine in a 50- to 75-ton cyanide mill. From 1943 to 1946 inclusive the Exploration Syndicate, Inc., operated the Carlisle group of mines under lease, producing complex gold-silver-copper-lead-zinc ores. Before converting the East Camp cyanide mill to flotation, a step which was completed in September 1944, the ores were milled in a selective flotation mill at Duncan, Arizona, owned by the Southwest Minerals Co. Mining by the Exploration Syndicate ended in 1946. The production of the company from 1934 to 1946 inclusive was around 17,000 ounces of gold, 1 million ounces of silver, 800,000 pounds of copper, 3 million pounds of lead, and 3 million pounds of zinc.

Much of the remaining production from the district came from the workings of the Carlisle mines by Veta Mines, Inc., and other lessees from 1936 to 1941, and by the Southwest Minerals Co. in 1941 and 1942. The latter treated its ore in the company-owned mill at Duncan, Ari-

zona. In addition to newly mined ore, dump material and old tailings were mined from the district.

In the region about Steeple Rock chiefly exposed are effusive rocks, the most important being a reddish, medium-grained variety that resembles in appearance the soda rhyolite of the Mogollon Mountains. In some of the canyons and mine workings other rocks are found, which appear to be intermediate in composition between andesite and basalt. A purplish diorite porphyry is exposed in the canyon just below the Carlisle mine, and rocks corresponding to diorite porphyry were encountered in the mine.

The ore deposits of the Carlisle district belong in the class of Tertiary deposits and are similar to those at Mogollon, Cochiti, and elsewhere. The veins, which are part of a complex system, commonly are marked by prominent siliceous outcrops. Quartz is the chief gangue mineral, but more or less calcite is present also.

TABLE 10. PRODUCTION OF METALS IN THE STEEPLE ROCK DISTRICT, GRANT COUNTY, 1932-1947

Year	Gold (ounces)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total Value
1932	13	780	-	-	-	$ 493
1933	2	94	-	-		64
1934	421	21,141	1,700	500		28,553
1935	407	19,490	2,200	-		28,414
1936	850	54,173	5,600	300	-	72,222
1937	5,552	200,863	57,550	68,175	55,000	364,258
1938	5,687	239,119	33,300	38,500	-	358,654
1939	4,487	237,030	13,000	19,000	-	320,183
1940	5,414	216,374	20,900	74,000		349,418
1941	6,685	252,509	53,200	226,000		432,697
1942	1,390	60,220	29,000	86,700	-	100,791
1943	250	20,870	202,800	683,000	703,500	177,158
1944	295	21,181	210,800	838,500	944,000	228,541
1945	963	25,494	232,200	1,079,500	1,156,400	309,004
1946	408	8,797	87,800	405,200	328,800	119,893
1947	203	3,765	33,700	193,000	133,250	66,822
1948-1954*	-	-	-	-	-	-
Totals	33,027	1,381,900	983,750	3,712,375	3,320,950	$2,957,165

* No production reported.

SWARTZ (CARPENTER) DISTRICT[22]

The Swartz district is on the western slope of the Black Range, close to the Sierra County line. It is about 6-7 miles southwest of Kingston, and about 25 miles east of Santa Rita.

The district has been known for many years, but mining and development work have been confined largely to two groups of claims, with the bulk of this work having been performed in recent years.

22. Hill (1946); Minerals Yearbooks.

The Royal John group of claims, known as the Royal John mine, has been known since prospecting began in the Black Range during the latter part of the last century. A mill, built in 1907 to concentrate the ore by jigs and tables, was unsuccessful. In 1928 the American Smelting and Refining Co. leased the property and operated the mine, shipping the ore to its Hanover mill.

Records of production from the Royal John group prior to 1904 are not available. The output for the years 1916-1946 inclusive, as taken from Government publications, was around 27,600 tons of ore, containing 10 ounces of gold, 38,000 ounces of silver, 10,000 pounds of copper, 1,570,000 pounds of lead and 2,470,000 pounds of zinc. Production from this mine was small in 1951-1953.

The Grandview group of claims also was prospected at an early date, but apparently little metal was produced until 1937, when a shipment of 110 tons of base-metal ore was made. Later the Black Range Development Co. leased the Grandview mine and made shipments of ore each year from 1938 to 1945 inclusive. The production during this period was 18,949 tons of ore, containing 15 ounces of gold, 13,963 ounces of silver, 92,999 pounds of copper, 1,758,490 pounds of lead, and 3,254,085 pounds of zinc.

The Black Range Development Co. also operated the Columbia mine, located a short distance from the Grandview, and shipped about 2,000 tons of ore from this mine in 1943 and 1944.

The basement rocks of the Black Range are granites, gneisses, and schists overlain by Paleozoic strata and capped by late volcanics. The formations range from El Paso limestone through the Montoya limestone, with possibly a small amount of Fusselman dolomite; they also include the Percha shale and Lake Valley limestone. The top of the range is capped by late rhyolites, andesites, and other volcanic rocks. In many places large faults and dikes have cut through the formations. Scattered ore deposits are found in several parts of the range. The ore bodies usually occur as replacement deposits in the limestone near faults or dikes. Zinc and lead are the common metals, with some silver, copper, and a small amount of gold. Smithsonite and cerussite are the principal minerals in the oxidized zone, being supplanted at depth by sphalerite and galena.

At the Royal John mine the known ore deposits are confined to a horst between two large premineral faults, the Mimbres on the west and the Owens on the east. Within this area are a number of known faults and probably some that are not known, as in many places the area is heavily wooded and covered with surface detritus.

At the Grandview mine the ore is found near the Grandview fault, which in turn is not far from the large Mimbres fault. The area is considerably broken up, which has allowed formation of ore deposits over a greater vertical span than at the Royal John mine.

Both the Grandview and Royal John mines began production again

in 1950 and are shipping lead-zinc ore to the American Smelting and Refining Co. mill at Deming.

TELEGRAPH DISTRICT

The Telegraph district is on the Gila River about 20 miles west of Silver City. Silver ore was discovered in the district in 1881, but the deposit soon was exhausted. A small lot of high-grade silver ore was shipped from the Bronx mine in 1920, and small lots of lead-silver and silver ore were shipped from the Calard No. 2, Cora Miller, and Slate Creek claims in 1941.

The district lies in an area of Precambrian granite and gneiss. In places remnants of sedimentary rocks are found, which seem to be narrow blocks faulted into the granite. Both granite and sedimentary rocks are cut by porphyry dikes. The silver ore occurs in oxidized fluorite-bearing quartz-pyrite veins.

The district has been inactive since 1941.

TYRONE DISTRICT

See Burro Mountain district, Grant County.

WHITE SIGNAL DISTRICT

The White Signal district is on the south side of the Big Burro Mountains, about 8 miles south of Tyrone. The country rock is Precambrian granite intruded by granodiorite porphyry. A number of quartz veins occur in the granite (Lindgren et al., 1910, pp 323-324). They are much oxidized but contain residuals of pyrite, chalcopyrite, galena, and locally sphalerite. Bismuth minerals are present in small amounts. A fair gold content is said to have been found in places.

The district has been prospected rather extensively for gold, silver, lead, and copper. Small shipments of ore were made nearly every year over a period of 20 or more years prior to World War II. From 1932 to 1941 there was also some placer mining, which produced several ounces of gold. The total production of the district is probably not over $50,000.

The White Signal district is notable chiefly because of the occurrence of the uranium minerals torbernite and autunite. These minerals thus far have been discovered in an area of approximately 1 square mile, located about 1 mile west of the White Signal post office. Uranium minerals have been found in some of the veins. They had been confused with the green copper carbonate stain which is locally present, until their true nature was recognized in 1918 by Mrs. A. A. Leach. Considerable exploratory work was done on the veins, but according to Hess (1922, p 416) "not enough torbernite could be found to make a valuable • radium ore, even with hand picking."

The district has yielded a small amount of radium-uranium ore, which has been used in drinking and bathing water and in the preparation of facial packs, toothpaste, and salves.

During the latter part of World War II the entire area was examined for uranium deposits by the U. S. Geological Survey. Since the war some prospecting for uranium has been carried on by private companies and individuals.

The country rock in the vicinity of the uranium deposits consists of Precambrian granite cut by a few felsite and pegmatite dikes and by numerous diabase dikes. Porphyry similar to the granodiorite porphyry of the Central districts occurs near the west end of the area. Many of the diabase dikes are very narrow in the uppermost outcrops, but widen considerably within a very short distance laterally and vertically. The uranium minerals occur in flakes in numerous small fractures and in small vugs; they seem to be most abundant in the thin decomposed edges of the diabase dikes, but equally good ores also occur at places in the adjacent granite. Gouge and seams of talcky material are prominent locally and are commonly ore bearing.

Mine workings extend to a maximum depth of 150 feet, at which depth uranium minerals are said to persist. Pyrite is present from a depth of about 80 feet down.

Some interest in the district was shown by the Atomic Energy Commission in 1950, when it was examined as a possible source of uranium ore. The findings of the commission have not been made public.

The Atraminas Mining Co., of Silver City, activated the Hummer and Lone Jack mines in 1952 and 1953. It is reported that this company shipped two cars of uranium ore to the Bluewater mill late in 1954.

GUADALUPE COUNTY

Guadalupe County occupies an area of 2,998 square miles in the east central part of the State. It has a population of 6,752. Santa Rosa, the largest town, is the county seat.

There is only one metal-mining district in the county, the Pastura, or Pintada, district. This district has produced 11,333,300 pounds of copper and 7,363 ounces of silver in 18 years of operation since 1925.

The ore is a sandstone containing chalcocite, azurite, malachite, and tenorite. It owes much of its value to the fact that it is low in sulfur (0.3 percent) and high in silica (80 percent). Production from the district reflects the need of this type of ore by the copper smelter at El Paso. Two mines have been worked in the district, the Stauber and the Pastura. The Stauber, the older and larger of the two, was discovered in 1915. It produced only 5,485 pounds of copper and 48 ounces of silver prior to 1925, when the property was acquired by I. J. Stauber, of El Paso, Texas.

PASTURA (PINTADA) DISTRICT

The Pastura mining district is located 17 miles southwest of Santa Rosa and 7 miles northeast of Pastura, both of which are serviced by

the Southern Pacific Railroad. Guadalupe siding on the same railroad is 2 miles from the mines of the district. All ore has been loaded on cars at this point for shipment to the smelter of the American Smelting and Refining Co., at El Paso.

The land and mineral rights on which the known ore bodies occur are privately owned. The mines are in the Plains region, at an altitude of about 5,300 feet, in a country devoted primarily to cattle and sheep raising. The winters are mild, and precipitation is light (about 14 inches in a normal year). Water suitable for human consumption is scarce.

TABLE 11. PRODUCTION OF METALS IN GUADALUPE COUNTY, 1925-1954

Year	Ore (dry tons)	Copper (percent)	Copper Recovered (pounds)	Silver (ounces)	Total Value
1925	3,268	5.24	34,300	-	$ -
1926	6,667	5.10	680,000	-	-
1927	6,511	4.60	599,000	-	-
1928	11,589	4.56	1,056,000	-	-
1929	16,187	4.75	1,537,000	-	-
1930	10,429	4.88	1,018,000	-	-
1931-1939*	-	-	-	-	-
1940	2,604	-	230,000	111	26,519
1941	2,411	4.40	204,000	232	24,237
1942	7,498	3.86	611,000	789	74,492
1943	17,327	-	1,258,000	1,889	164,953
1944	8,864	-	595,000	308	80,544
1945	1,850	-	93,000	-	12,555
1946	-	-	-	-	-
1947	-	-		-	-
1948	-	-	-	-	-
1949	5,526	-	152,000	3,991	33,556
1950	18,469	-	640,000	43	135,317†
1951	-	-	960,000	-	228,867
1952	-	-	964,000	-	271,402
1953	-	-	602,000	-	163,206
1954	-	-	100,000	-	27,107
Totals	119,200		11,333,300	7,363	$1,242,395

* No production.

† Includes $2,160 for lead.

The copper-bearing sandstone belongs in the Santa Rosa member of the Dockum series. The mineralization is confined to one bed only, which varies in thickness from a few to 18 feet. It is not regular in its intensity or in its distribution in the sandstone. In some places the entire thickness of the bed may be ore, in others only the lower few feet may be mineralized sufficiently to be ore. Frequently the entire bed is barren or only slightly mineralized.

The Stauber mine was operated from 1925 until 1930, and was again in production in 1940. It was closed down at the end of World War II. Production was resumed in 1949 and continues at this time. Some 300 tons of ore per day is being shipped to the El Paso smelter. This mine

has accounted for over 90 percent of the total production from the district.

The Pastura mine is located on an isolated body of ore a short distance from the Stauber property. It produced during 1943 and 1944, but has not been active since that time.

There are many occurrences of copper in the Red Beds of New Mexico, but the Pastura district is the only occurrence that has yielded an important amount of ore. The genesis of the copper in the Guadalupe County deposits is not known.

HARDING COUNTY

Harding County is situated in the northeast quarter of the state. It has an area of 2,136 square miles, and its population is 3,039. Mosquero, the county seat, is the largest town. It lies on the Dawson branch of the Southern Pacific Railroad and is a noted cattle shipping point.

Harding County has no mining district, although on several occasions some excitement has been engendered by the reports of placer gold finds in the sands of Ute Creek, the principal drainage channel of the area. These periods of excitement have been short lived, as the reports were never substantiated.

In the southern part of the county, along the Canadian River escarpment, some copper mineralization is known to occur in a bed of shaly sandstone. The mineral found is chalcocite and occurs as a cementing material in the sandstone. The exposed mineralization has not been sufficiently strong to justify intensive prospecting. A few shallow pits are found along the outcrop.

HIDALGO COUNTY

Hidalgo County, separated from Grant County in July 1920, is in the extreme southwest corner of the state. It occupies an area of 3,447 square miles and has a population of 5,110. Lordsburg, located on the main line of the Southern Pacific Railroad, is the county seat. This area is part of the Basin and Range province and is characterized by a number of sharply marked, narrow mountain ranges, which trend north and south and are separated by wide, gently sloping, arid valleys. The metalliferous deposits are scattered and differ widely in character. Copper, gold, silver, and lead are the principal metals produced.

Production prior to 1920 is included in statistics for Grant County. The accompanying table gives the annual production since 1920.

APACHE NO. 2 (ANDERSON) DISTRICT[23]

The Apache No. 2 district lies at the southwestern base of the Apache Hills, a small group of rounded hills 6 miles south-southeast of Hachita.

23. This district is not to be confused with the Apache (Chloride) district in Sierra County.

The mineralized zone is said to extend into the Sierra Rica group of hills in Mexico. Production from this district has been small.

The Apache Hills (Darton, 1928-a) consist mainly of intrusive quartz porphyry overlain by Tertiary volcanic rocks to the north and in contact with Comanche and Magdalena limestones to the south.

TABLE 12. PRODUCTION OF METALS IN HIDALGO COUNTY, 1920-1954*

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total Value
1920-1924	$ 701,946	654,404	15,868,154	1,008,086	-	$ 3,684,886
1925-1929	1,099,622	657,384	22,894,157	3,133,825	-	5,061,958
1930	289,943	194,104	4,863,500	504,200	-	1,022,138
1931-1932†	-	-	-	-	-	-
1933	2,297	1,849	21,000	24,000	-	5,176
1934	23,603	10,386	35,600	24,000	-	33,886
1935	34,750	16,178	89,000	47,500	-	55,665
1936	48,496	32,417	817,000	91,000	-	152,953
1937	74,919	75,196	3,807,000	53,200	-	597,077
1938	144,606	138,736	6,380,400	159,600	-	866,915
1939	154,210	135,982	6,376,000	52,600	-	912,089
1940	87,570	81,945	6,561,000	157,000	-	895,562
1941	47,495	67,815	7,468,800	221,000	80,000	995,634
1942	48,090	135,045	6,716,000	292,000	197,000	994,643
1943	51,695	98,259	502,300	278,000	87,000	804,804
1944	81,095	115,051	4,718,000	349,000	78,000	836,651
1945	49,385	92,347	2,294,000	690,000	-	484,084
1946	55,370	100,963	2,392,000	215,000	-	547,887
1947	64,645	192,643	3,540,900	713,500	96,600	1,097,008
1948	59,500	178,853	3,342,600	354,000	322,000	1,071,005
1949	69,545	156,641	3,870,000	762,000	72,000	1,103,027
1950	24,990	96,295	4,124,000	310,000	8,000	1,012,320
1951	26,425	90,806	3,042,000	466,000	66,000	937,403
1952	28,700	72,606	2,950,000	288,000	118,000	874,268
1953	42,420	101,222	3,988,000	132,000	4,000	1,296,339
1954	29,030	97,575	4,412,000	-	-	1,246,303
Totals	$3,340,347	3,594,702	121,073,411	10,321,011	1,128,600	$26,589,681

* Prior to 1920 production from Hidalgo County was included with Grant County.
† Production figures not available.

The ore occurs in oxidized contact-metamorphic deposits. These deposits generally follow certain strata which have been recrystallized to coarse calcite. Some horn-silver ore was shipped in the early days of the district, but the main production prior to 1939 was low-grade oxidized copper ore containing gold and silver. Scheelite occurs in some of the deposits in appreciable quantities, but none has been produced commercially. Bismuth is reported also in some of the ore.

In 1937 the United States Smelting Refining and Mining Exploration Co. instituted exploratory work in the Monarch and Copper Crown claims of the Apache group. This work was completed in June 1938, and the lease terminated.

The district produced a small amount of ore in 1934, but was not credited with further production until 1942, when a car of high-grade zinc ore was shipped to the Ozark Smelting and Mining Co., at Coffeyville, Kansas. Small shipments of high-grade copper-lead-gold ore were made to the El Paso smelter in 1943 and 1944. No ore production has been reported from this district since 1944.

Some interest was shown in the district in 1950, but no production developed.

FREMONT DISTRICT

The Fremont district is about 20 miles southeast of Hachita, in the northwestern foothills of the Sierra Rica. The junction of the Luna-Hidalgo County line and the international United States-Mexico boundary line lies within the district. Most of the mineralization is in Mexico.

The rocks of the region consist of Pennsylvanian and Cretaceous limestone (Darton, 1928-a, p 348) cut by intrusions of granite porphyry and lamprophyre. The ore deposits on the American side of the line occur as replacement bodies in the limestone and as quartz veins along faults. The replacement bodies generally are oxidized and carry copper, lead, and zinc minerals intermixed with quartz and oxides of iron and manganese.

The quartz veins generally follow a northeast fault system. Iron and manganese oxides are prominent in the outcrops, and carbonate and sulfide ore minerals are present in the upper parts of the veins. The valuable minerals are galena, chalcopyrite, and gold.

The district has long been idle, and no record of production is available prior to 1947, when 54 tons of high-grade copper-gold-silver ore was shipped from the Yucca claim. In 1948, 90 tons of ore was produced from the same claim.

GOLD HILL DISTRICT

The Gold Hill district, north of Lordsburg, produced a small amount of ore between 1934 and 1940. Most of the ore came from the Oro Grande, Bob Cat, and Lost Prospector mines. The value of the production from this district is not available.

HACHITA (EUREKA, SYLVANITE) DISTRICT

The Hachita district is in the Little Hatchet Mountains, about 12 miles southwest of the town of Hachita. It includes the two smaller districts of Eureka and Sylvanite. The line between Hidalgo and Grant Counties crosses the range between the two districts. The ore deposits of the Little Hatchet Mountains are varied, but none has proved of great economic importance. A detailed study of the geology and mineral occurrences in the region was made by Samuel G. Lasky (1947), of the U. S. Geological Survey.

The Hachita district was discovered in 1880. In 1908 a gold boom was started in the Sylvanite district when placer gold was discovered while work was being done on some of the copper claims. The total output from the district has been less than $1 million. A car of arsenic ore was shipped from the district in 1924. Sporadic production has continued from the area to the present time. Most of the placer production occurred during the short boom period. The total value of the gold recovered from gravels was not great.

The Eureka district is at the northern end of the Little Hatchet Range. The chief minerals found are argentiferous galena, zinc blende, pyrite, chalcopyrite, chalcocite, and stibnite. The deposits occur as veins and as bedded and irregular bodies in Paleozoic limestone and Cretaceous strata. Minor intrusive porphyry masses are abundant, and the sedimentary rocks are locally metamorphosed. The tungsten ore wolframite occurs in some zones. The gangue is chiefly calcite and garnet.

The Sylvanite district adjoins the Eureka district on the south. The ores of the two districts are similar, but the occurrences differ. In the Sylvanite district the mineralization occurs chiefly in quartz veins in a large mass of quartz monzonite cut by lamprophyre and syenite dikes, and in the Magdalena limestone which adjoins the porphyry on the south. The ores near the surface contain free gold associated with tetradymite in sericite, as well as in iron-stained quartz. Chalcopyrite and pyrite appear at a depth of about 30 feet. The district also contains a deposit of pyrrhotite and chalcopyrite replacing the cement in a quartzitic sandstone.

This district has produced small amounts of copper-gold-silver ore each year since 1933. The ore has come from many groups of claims, the more important being the Barney, Hardscrabble, Last Chance, Little Mildred, and Rincon. In 1934 the Hidalgo Gold Mines Co. erected buildings, installed mining equipment, and did extensive exploratory work in the Hardscrabble group. That year some 650 tons of ore was shipped from the district to the smelter at El Paso. Subsequent annual production has not been so large. The last shipments of ore reported from the district came from the Hornet mine in 1953.

LORDSBURG (PYRAMID, VIRGINIA) DISTRICT

The Lordsburg district is in the northern part of the Pyramid Mountains, 3-10 miles southwest of Lordsburg. It includes two subdistricts, the Shakespeare (or Virginia) at the north and the Pyramid at the south. Prospecting in the district began in 1870. Silver was the metal chiefly sought, and rich ores of this metal were found in the Leidendorf (Venus, Viola) and the Last Chance mines in the Pyramid district. Copper, lead, and gold also were produced. A smelter was built in 1881 in the Virginia district and a stamp mill at the Leidendorf mine the following year, but neither operated for long. During the present century the district has

been chiefly a copper producer, the production of other metals being incidental. The importance of the district as a copper producer was established chiefly by the Calumet and Arizona Mining Co. through the production of its Eighty-five mine. In 1930 this mine produced at an average monthly rate of 800 ounces of gold, 8,600 ounces of silver, and 390,000 pounds of copper (Youtz, 1931). The mine was acquired by the Phelps Dodge Corp. in 1931. Operations were suspended, and pumps drawn, on January 1, 1932.

In 1933 the Bonney mine was the chief producer. This mine, together with the Miser's Chest and the Hope, Faith, and Charity group, accounted in 1934 and 1935 for all the production from the district. In 1936 the Banner Mining Co. leased the Bonney group of claims, erected a 200-ton flotation mill, and in August began producing concentrates. This mine immediately became the most important producer in the county. In 1937 the capacity of the mill was increased to 500 tons per day, and a large-scale prospecting and development program was initiated. Many improvements were made in the surface plant. In 1941 the company leased the old Anita mine, about 5 miles away. This was brought into production the following year, the ore being trucked to the Bonney mill. The same company acquired the Miser's Chest mine in 1945 and has steadily maintained its position as the major copper producer in Hidalgo County. Large-scale production from the Bonney group continues to the present time.

From 1933 until 1939 there was some ore production from several properties other than the Banner Mining Co. holdings, the most notable contributors being the Miser's Chest, Atwood, Battleship, Belle, Depression, Nellie Bly, and Silver Dollar. The Miser's Chest Mining and Milling Co., Inc., was organized in 1939, operating the Miser's Chest mine until it was acquired by the Banner Mining Co. in 1945. The National Zinc Co. leased the Ruth mine in 1942, shipping ore to the custom mill at Hanover.

Late in 1942 the U. S. Bureau of Mines started an exploratory diamond-drilling program on the Atwood group of claims. After the old shaft and workings were repaired, this mine came into production in 1943. The Waldo and Tom groups also produced that year. Operated soon thereafter by C. H. and S. A. McIntosh, the Atwood mine within a short time became the largest producer of gold and silver, and the second largest producer of copper, in the county. The Waldo was operated as the Millsite mine by the Lordsburg Mining Co. in 1947. In the same year the Walrich Mining Co. operated the Tom group. Some production also is being obtained from lesser properties in the district, including some ore sorted from the dump of the Eighty-five mine, which is still being held idle by the Phelps Dodge Corp.

The Lordsburg district not only is the most important district in Hidalgo County, but it has made that county the second most important producer of metals in the State, surpassed only by Grant County.

The rocks of the Lordsburg district are of igneous origin. They consist of basaltic andesite and subordinate associated volcanic rocks intruded by an irregular granodiorite stock of late Cretaceous or early Tertiary age. Tertiary volcanic tuffs, sands, and breccias fringe the northern part of the area and are said to be predominant in the Pyramid district, particularly near the Last Chance mine at the south end. Quartz latite plugs cut the fragmented rocks. A large part of the Pyramid district is covered by Quaternary debris, and rock exposures are few.

Vein outcrops are prominent in the Virginia district, where they form bold, wall-like ledges locally called siliceous dikes. They strike northeast and east, but members of the two sets join, cross, and change in strike from one set to another. In the Pyramid district vein outcrops are uncommon, owing to the gravel cover, and are inconspicuous. Nearly all veins dip steeply and are faults of small throw. Movement along them has been nearly horizontal. They have been cut and offset slightly by postmineral faults that strike at about right angles to the veins. Movement along these postmineral faults has been approximately along the dip.

The deposits of the Virginia and Pyramid subdistricts differ in character and presumably in origin. In the Virginia district they are the copper-tourmaline type of deep vein zone, one of the few occurrences of this type in the United States. The veins are chiefly fissure fillings along shear zones which were reopened repeatedly during mineral deposition. Five periods of reopening have been identified, the latest movement being contemporaneous with the postore faulting. Each reopening was accompanied by a recognizable change in the material deposited. The resulting vein filling is commonly a highly vuggy and drusy mass, in which mineral sequences are fairly clear. Postore movement has occurred along all veins, almost invariably following the wall and forming thick masses of gouge and breccia along them.

The Emerald vein of the Eighty-five mine, in the Virginia district, has been of notable importance. Traced on the surface for over 5,000 feet, it was mined from the surface to a vertical depth of 1,900 feet and for an average of 2,300 feet along the strike. Ore was encountered in development work for an additional 300 feet of depth.

The productive part of the Emerald vein lies within the granodiorite stock, about 95 percent of all ore mined having come from where granodiorite formed one or both walls. The vein is fairly regular and has an average width of about 5 feet. The grade of ore has been remarkably constant. The primary ore minerals consist of chalcopyrite and minor amounts of pyrite, sphalerite, and galena. Sphalerite and galena are locally prominent. The gangue is predominantly drusy quartz. Calcite, some of it manganiferous, is conspicuous here and there, and small amounts of specularite, barite, and tourmaline are present. Wall-rock alterations consist of replacements by quartz, sericite, and chlorite and impregnations of specularite and tufts of tourmaline. The depth of sec-

ondary alteration and the location of secondary and oxidized ore bodies are erratic. Secondary ores have been mined as deep as 1,500 feet below the outcrop and 1,200 feet below the present water level. The secondary minerals are chiefly azurite, malachite, and chalcocite, and include also native copper, cuprite, chrysocolla, covellite, and a little wulfenite.

In the Pyramid district to the south the veins contain gold and silver minerals along with the copper, which is the chief metal of economic importance in the district. The gangue consists largely of quartz but includes some barite and the carbonates rhodochrosite, siderite, and calcite. In the early days of the district cerargyrite was the important ore mineral, but chalcopyrite has been the chief ore mineral since 1930. The principal mines of the district are the Bonney, Miser's Chest, Atwood, Waldo, Ruth, and Anita. The Atwood is the chief producer of gold and silver in the district.

RED HILL (GILLESPIE) DISTRICT

The Red Hill district is in the Animas Mountains, about 30 miles southwest of Hachita and 22 miles south of Playas. A small production was reported from the district yearly from 1905 to 1913, and again from 1920 to 1930.

The production for these periods came chiefly from a single mine, the Red Hill group. The Red Hill Mining Co. operated this property in 1938, shipping lead-silver-gold ore to the smelter at El Paso. The Hope Mining Co. shipped 88 tons of ore from the same group in 1941. Shipments of ore were reported also in 1945, and again in 1947, the 1947 shipments including 762 tons of old mill tailings.

The country rock in the district is primarily Tertiary volcanics, and the ores are oxidized lead ores containing gold, silver, and copper.

STEINS PASS-SAN SIMON DISTRICT

These two districts are here combined because the production statistics and general information contained in the U. S. Bureau of Mines Minerals Yearbooks treat them as one district.

The Steins Pass district is in the northern extension of the Peloncillo Mountains. It lies close to the Arizona line, just north of the pass traversed by the main line of the Southern Pacific Railroad and U. S. Highway 80. The San Simon district begins at the above-mentioned pass and extends southward along the west slope of the Peloncillos about 10 miles to Granite Gap.

These districts have been known since 1875. Prior to 1930 they had produced approximately $11/2 million in gold, silver, lead, and copper. Since 1930 there has been some production almost every year. Among the producing mines have been the "66," Bob Montgomery, Hattie Lee, Carbon Hill, Painted Horse, McGhee, Central, Silver Hill, Crosby, Sweet, and others. In 1943 the Shattuck Denn Mining Co. operated the McGhee under lease for several months. This mine seems to have been

the most consistent recent producer in the district. It operated intermittently until June 1948, when fire destroyed the headframe, shaft timbers, and surface buildings.

The ores produced in the two districts have been lead, zinc, copper, gold, and silver. These have been milled in the district, shipped to custom mills or smelters, or sold to ore buyers in Douglas, Ariz., or Silver City.

The principal rocks in the Steins district are rhyolite, diorite porphyry, and monzonite porphyry. The monzonite porphyry forms the prominent dikes. Some faulting has taken place. The veins follow silicified brecciated zones in the country rock. Most of the ores are oxidized, but pyrite, chalcopyrite, galena, and sphalerite are present. Silver and gold account for most of the values.

The ores of the San Simon district occur as replacement bodies in limestone along or near the porphyry dikes. The ore bodies are pockety and irregular. The ore is mostly oxidized and consists mainly of argentiferous cerussite. A little copper, zinc, and arsenic are also present, as are much limonite and plentiful manganese oxides.

Some contact-metamorphic deposits occur in the district. The metamorphosed limestone is characterized by garnet, wollastonite, and pyroxene.

LEA COUNTY

Lea County is the most southeasterly county of the State. It is bordered by Texas on the east and south. The county has an area of 4,393 square miles, and a population of 30,577. The county seat is Lovington. Hobbs, the largest city, is the "oil capital" of New Mexico. Both communities are located on a branch line of the Texas and Pacific Railway.

Lea County has no mining districts and no known occurrence of metallic ores. Nonmetallic mineral deposits are important.

LINCOLN COUNTY

Lincoln County occupies an irregular area of 4,859 square miles in south central New Mexico. It has a population of 7,731. Carrizozo, located on the Southern Pacific Railroad, is the county seat. The White, Jicarilla, Capitan, and Gallinas Mountains occupy the central and southern part of the county. These mountains consist of monzonite porphyry intrusive into Paleozoic and Cretaceous sediments. The northern and eastern parts of the county are underlain chiefly by strata of the Chupadera (Permian) formation.

The principal mineral deposits are gold bearing, and all occur in the mountain belt. Both lode and placer deposits have been worked. Production prior to 1930 was valued at between $3 million and $4 million, most of which came before 1904.

TABLE 13. PRODUCTION OF METALS IN LINCOLN COUNTY, 1904-1954

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
Prior to 1904	-	-	-	-	-	$3,000,000†
1904	$ 28,596	2,576	-	2,261	-	30,183
1905-1909	118,930	9,284	16,299	15,488	-	127,461
1910-1914	215,529	3,809	32,868	220,796	-	232,358
1915-1919	86,614	2,739	48,158	13,277	-	101,289
1920-1924	51,241	17,590	321,260	1,290,113	-	190,268
1925-1929	989	2,381	7,391	33,218	-	5,375
1930	133	179	700	12,900	-	938
1931	-	-	-	-	-	-
1932	-	-	-	-	-	-
1933	14,542	289	1,000	140,000	-	15,225
1934	36,406	512	4,400	139,000	-	37,603
1935	31,269	455	2,000	179,000	-	32,470
1936	14,935	594	250	200	-	15,869
1937	7,182	357	100	5,800	-	7,482
1938	5,852	458	100	200	-	6,425
1939	9,205	84	-	200	-	9,262
1940	11,585	675	100	-	-	12,086
1941	8,085	758	-	-	-	8,635
1942	1,260	4	-	-	-	1,263
1943	-	-	-	-	-	-
1944		-	-	-	-	-
1945	-	-	-	-	-	-
1946	35	5	-	1,000	-	148
1947	-	-	-	-	-	-
1948	35	854	10,00	74,000	16,000	18,352
1949	1,400	21	-	-	-	1,420
1950	1,680	43	-	-	-	1,719
1951-1953*	-	-	-	-	-	-
1954	2,014	-	-	-	-	2,014
Totals	$647,517	43,667	444,626	2,127,453	16,000	3,857,845

* No production reported.

† Estimated.

ESTEY (OSCURO) DISTRICT

Estey is 14 miles northwest of Oscuro, a station on the Southern Pacific Railroad. It lies at the southeastern edge of the Oscuro Mountains, which extend southward from Socorro County. Although the presence of copper minerals had been known for many years, it was not until 1900 that an effort was made to mine them. The district has been idle since about 1910.

The ore occurs in the Abo Red Beds formation, which is repeated at the surface several times because of a number of faults. Ore is found in three horizons, the most important of which is the arkose at the base of the Red Beds. The copper-bearing layers are thin, for the most part only a few inches to 3 feet thick. Ore also occurs in cross fractures and prominent joints. Malachite is the chief ore mineral. The small amount of sulfide ore consists chiefly of chalcocite, which has replaced the calcite

cement of the arkose and sandstone. The chalcocite is associated commonly with a coaly material in the arkose. The ores carry a small amount of gold and silver. Small amounts of coal and other carbonaceous matter have been noted in the gangue material.

GALLINAS MOUNTAINS (RED CLOUD) DISTRICT

The Gallinas Mountains are about 10 miles west of Corona, a station on the Southern Pacific Railroad at the north edge of the county. In the early days of this district, ore was hauled by ox team nearly 100 miles to the Socorro smelter. In recent years the ore has been shipped to the smelter at El Paso.

The most important producers have been the Deadwood and Red Cloud mines. The Red Cloud shipped 1,015 tons of lead-zinc-copper-silver ore in 1948 and 91 tons of lead-silver ore in 1949. Small production of ore from the district has continued to the present time. No accurate production figures for the district are available.

Since 1950 this district has produced small amounts of bastnaesite, an ore of rare-earth elements.

JICARILLA DISTRICT

The Jicarilla district is in the Jicarilla Mountains, about 8 miles southeast of Ancho, the nearest railroad station on the Southern Pacific. Certain stream beds of the district are said to have been worked for placer gold as early as 1850, but prospecting for lode deposits was not undertaken until the eighties.

Only a small part of the placer deposits has been worked, and operations have been intermittent and on a small scale. The placers produced small amounts of gold each year from 1931 to 1942. They were again active in 1948 and 1949. The gold-bearing gravels occur at numerous places in the district and were derived from weathering of nearby lode deposits. The gold is fine grained and angular, and some particles still adhere to bits of vein quartz. It has a fineness of about 920. The chief producing placer deposits have been the Ancho, the Rico, and the Warners Gulch properties.

The gold lode deposits occur in the quartz-monzonite porphyry that forms the main mass of the Jicarilla Mountains. The porphyry is traversed by many joints, and quartz and auriferous pyrite occur along the fracture planes. Some of the veins contain copper and silver in addition to the gold. The lodes range in width from a few inches to over 40 feet. Water level and limits of oxidation change from place to place, and free gold occurs only where the pyrite has been oxidized. Some copper ore has been found in the limestone. In places limestone has been replaced by pyrite, which by oxidation has yielded high-grade iron ore.

The Lucky Strike and a few other lode prospects yielded 130 tons of gold ore in 1933. This is the last production of lode ore reported from the district.

NOGAL DISTRICT

The Nogal district is rather indefinite in extent and is generally considered to include the subdistricts of Vera Cruz, Nogal, Parsons (Bonita), Schelerville (Church Mountain), Alto (Cedar Creek), and several isolated prospects in the same region.

The district lies mostly on the eastern side of the Sierra Blanca, which in this vicinity consists mostly of monzonite porphyry. The monzonite is cut by dikes of finer grained diorite porphyry, and andesite flows and tuffs occur locally.

Placer gold was found in the Nogal district as early as 1865, and lode claims were located in 1868. Active prospecting did not really begin until 1882, when the region was withdrawn from the Mescalero Indian Reservation.

Production from the entire district prior to 1910 was valued at $250,000. There was little mining activity in the district from 1910 to 1931. Small-scale operations were resumed in 1933 and were continued through 1940. The Helen Rae lode produced gold ore from 1933 to 1937; most of the ore was milled at the property. Some placer gold, also, was recovered during these years. The chief placer producers were the Dugan-Dixon and those located in Dry Gulch.

In 1936 the Great Western property was equipped with a 75-ton mill and amalgam plates, and development work was started at the Silver Plume and Bonita properties. The Great Western milled gold ore in 1937, and small lots of ore from the Bonita were shipped to the El Paso smelter. Development work continued at the Silver Plume, and at the Gold Pick and Crown Gold-Silver groups of claims.

The Great Western yielded 30 tons of good gold ore in 1938 and 84 tons in 1939. The concentrates were shipped to El Paso. Twelve tons of ore was recovered from the Silver Plume and other prospects during 1938 and 1939. A small amount of work was done in the Cedar Creek subdistrict in 1940 and 1941, and a little lead-silver ore was produced from the Silver Cap No. 2 lode. Since that period, the district has been idle.

Most of the ore in the district occurs in stringers and lodes in the porphyry and contains chiefly gold, pyrite, and sphalerite in a gangue of quartz and dolomite. Galena and chalcopyrite occur sparingly. Gold also occurs in veins in the andesite, which are almost free from sulfides other than pyrite, and in low-grade deposits in altered porphyry. Several copper and lead-silver prospects have been worked in addition to the gold deposits.

WHITE OAKS DISTRICT

White Oaks is about 10 miles northeast of Carrizozo, a division point on the Southern Pacific Railroad. A small amount of placer gold was produced from the White Oaks area in the fifties and sixties, but lode deposits were not discovered until 1879. Mining was conducted with

considerable vigor during the eighties and nineties, several mills being erected to treat the ore. Production to 1904 was valued at $2,860,000. Since that time production has been comparatively small, probably not greatly exceeding $3 million by 1930.

The Old Abe was the most important producer in the district. The veins of this mine were worked to a depth of 1,400 feet, but the richest ore occurred near the surface in high-grade pockets and shoots. The Homestake stamp-amalgamation mill treated ores from the North Homestake and South Homestake mines and produced small amounts of bullion each year until 1926.

There was some production from the district from 1933 through 1941. The Little Mack and the Smuggler were the chief producers in 1933 and 1934. Most of the ore was shipped to El Paso, but the Little Mack Mining Co. milled 100 tons of gold ore at the property.

In 1934 the El Aviador Gold Mining Co. shipped ore from the Little Nell and the Smuggler. The Homestake mill burned in 1934. Some placer gold was recovered during this period from Baxter and White Oaks Gulches.

The El Aviador company shipped 612 tons of ore to El Paso and milled 117 tons at the Little Mack mill in 1935. Small shipments of ore were made by the Lincoln County Mining and Milling Co. in 1936-1938, and the Big Four Gold and Tungsten Mines Co. sank 100 feet of inclined shaft and drove 75 feet of drift, from which 100 tons of gold-silver ore was recovered in 1939. Small shipments of gold ore also were made in 1940.

Some placer mining was carried on in Baxter and White Oaks Gulches throughout the period 1933 to 1941.

The district has been idle since 1941. The gold deposits of the White Oaks district are found in a fine-grained monzonite, which is intruded into Cretaceous shales. Both igneous and sedimentary rocks are cut by lamprophyre dikes. The deposits form narrow stringers and moderately wide lodes, which cut the monzonite, the dikes, and the shale. They contain an unusual association of minerals; albite, wolframite, hübnerite, tourmaline, fluorite, and gypsum are present in addition to quartz, gold, and auriferous pyrite.

LOS ALAMOS COUNTY

Los Alamos is the smallest and youngest county in the State. It has an area of 110 square miles and a population of 10,467, thus being, with the exception of Bernalillo, the most densely populated of all the counties. It was established in 1949. The county seat, and only town in the county, is Los Alamos.

The only industry is atomic research and development. There are no known metallic mineral resources in the county.

LUNA COUNTY

Luna County occupies a rectangular area of 2,957 square miles in southwestern New Mexico. It borders Mexico on the south, Hidalgo and Grant Counties on the west, Grant and Sierra Counties on the north, and Dona Ana County on the east. Two lines of the Southern Pacific Railroad cross the county from east to west. A branch of the Atchison, Topeka and Santa Fe Railway enters Deming from the northeast and continues to Silver City, in Grant County. The county has a population of 8,640. Deming is the county seat.

The southern termination of the Mimbres Mountains, or Black Range, lies in the north central part of the county, nearly due north of Deming, and is known as Cooks Range. The rest of the county is topographically similar to Hidalgo County, though the mountain ranges are not so well marked and regular. The most prominent ranges in the southern half of the county are the Big and Little Florida Mountains, just southeast of Deming. Other ranges are the Cedar, Tres Hermanas, and Potrillo Mountains, neither extensive nor high, yet contrasting sharply with an otherwise gently rolling plains country. Precambrian granite and Paleozoic sediments are the principal rocks in the Florida Mountains and the western part of the Mimbres Mountains. Most of the other mountains and hills consist predominantly of Tertiary and Quaternary lavas.

Eight mining districts are recognized in the county, but only four have been sources of important production. In 1930 only one district was active. Lead ores have been mined in the Cooks Peak district, lead-silver-gold ore in the Victorio and Tres Hermanas Mountains, and manganese in the Florida Mountains. Minor mineralization occurs in some of the ranges. The Empire Smelting and Refining Co. operated a lead smelter at Deming for several years prior to 1917. The Peru Mining Co. constructed a custom selective-flotation concentrating mill at Wemple, near Deming, in 1928, and the American Smelting and Refining Co. constructed a large-capacity selective-flotation mill in 1948-1949. Located near Deming, the latter also is a custom mill. Both mills were active until the middle of 1952.

The total value of the metals, exclusive of manganese and tungsten, produced in Luna County prior to 1931 was nearly $6.2 million, about $4.3 million of which was produced before 1904.

CARRIZALILLO HILLS DISTRICT

The Carrizalillo Hills are in southwestern Luna County adjacent to the Mexican border. The chief rocks are extrusive volcanics. The area has been prospected at many points, and small shipments of high-grade copper-gold ore have been reported.

There has been very little activity in the district for many years.

TABLE 14. PRODUCTION OF METALS IN LUNA COUNTY, 1904-1954

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total Value
Prior to 1904	-	-	-	-	-	$4,300,000*
1904	$ 1,695	8,549	16,000	671,772	-	37,605
1905-1909	17,365	33,090	7,049	3,128,363	328,836	197,128
1910-1914	17,128	72,666	5,495	2,800,161	1,954,210	294,906
1915-1919	22,377	63,639	11,691	2,612,348	5,717,320	947,047
1920-1924	10,034	22,632	7,157	938,625	45,326	104,657
1925-1929	1,783	12,499	7,902	1,033,400	189,300	107,786
1930	306	904	500	51,000	-	3,269
1931	-	-	-	-	-	-
1932	-	-	-	-	-	-
1933	6	143	-	20,000	-	796
1934	32	1,245	200	49,100	-	2,670
1935	217	380	-	7,400	-	786
1936	147	745	250	16,700	-	1,515
1937	3,276	3,722	3,000	74,400	-	10,908
1938	13,909	13,676	6,000	256,700	-	35,146
1939	15,925	17,397	9,500	332,800	9,000	44,832
1940	3,955	4,175	2,600	107,000	49,000	15,655
1941	490	218	200	26,400	-	1,684
1942	-	339	-	32,000	-	5,851
1943	-	-	-	6,000	22,000	2,826
1944	-	-	-	-	-	-
1945	-	-	-	-	-	-
1946	-	26	-	-	-	21
1947	875	3,093	2,900	134,500	42,000	28,806
1948	70	958	-	14,678	-	15,615
1949	-	221	-	38,000	-	6,204
1950	35	336	-	10,000	-	1,689
1951	350	2,970	6,000	464,000	522,000	179,766
1952	105	1,222	2,000	190,000	188,000	63,493
1953	-	57	-	4,000	-	581
1954†	-	-	-	-	-	-
Totals	$110,080	264,902	88,444	13,019,347	9,066,992	$6,411,242

* Approximation.

† No production reported.

COOKS PEAK DISTRICT

The Cooks Peak district is on the north side of Cooks Peak, the highest mountain of the range. It is about 19 miles north of Deming. Ore was discovered about 1876, but the important deposits were not located until 1880. The rich oxidized lead ores were particularly desired by the smelters, and the district was very active for some time. Production up to 1904 has been valued at about $3 million, of which four-fifths represents lead and one-fifth silver. The district was much less active after 1904, and was shut down in 1928. Production from 1904 to 1927 is valued at $896,901.

The district was partly revived in 1933, when the Faywood mine shipped ore to the El Paso smelter. The Ethel 85 began shipping small

amounts of ore in 1935, and continued making small shipments each year until 1942. The Lookout mine sold a small amount of high-grade lead-zinc ore to the Ozark Pigment Co., at Coffeyville, Kansas, in 1938. This mine, together with several prospects in the district, made frequent small shipments to the Ozark Co. through 1942. The prospects contributing to these shipments were the Busted Banker, Gladys, Graphic, and Mickey groups.

In 1947 the Ethel 85, Gladys, Montezuma, Goodwill, Ray Parker, and Wallace properties produced 77 tons of high-grade lead-silver ore. Production was increased to 408 tons in 1948, but dropped to only 69 tons in 1949. In 1951 and 1952 the Mahoney group, including the Superior, Silver Queen, and Copper King, produced 13 ounces of gold, 4,161 ounces of silver, 8,000 pounds of copper, 646,000 pounds of lead, and 683,400 pounds of zinc.

Cooks Peak is a massive body of granodiorite porphyry, intrusive chiefly into lower Paleozoic limestone and shales, but locally penetrating the Cretaceous beds. The ore deposits occur under broad arches in the upper silicified part of the Fusselman (Silurian) limestone, locally called the Mimbres limestone, just below the Percha (Devonian) shale. The ore bodies are characteristically irregular in size, shape, and distribution. The ores contain cerussite, smithsonite, limonite, galena, sphalerite, and pyrite. The silver content is appreciable.

COOKS RANGE MANGANESE DISTRICT

The manganese deposits of the Cooks Range district are at the southern end of the range, a few miles northeast of Mirage, a station on the Deming-Rincon branch of the Atchison, Topeka and Santa Fe Railway. Small amounts of ore were marketed during World Wars I and II.

The ore occurs in veins and as replacement bodies in andesite, and as a cementing material of andesite breccia. Most of the ore consists of psilomelane. Manganiferous calcite is present in places, and fluorite shows in some of the workings. Some concentrates were obtained by treating the surface debris, which contains a little psilomelane float.

FLORIDA MOUNTAINS DISTRICT

The Florida Mountains are about 15 miles south-southeast of Deming. Many mining claims have been located in these mountains, but ore deposits of economic importance have been found on only a few. No authentic reports are available as to the value of the ore production from this district; however, it is thought to amount to not over $100,000, most of which was recovered in the early days of the district.

A small amount of copper ore was shipped in 1934-1936 and 1937, and two tons of high-grade lead ore was mined in 1948 by Rhea and Moore.

The principal ores of the district were partly oxidized silver-bearing lead and zinc minerals in limestone. Several small lodes of copper sulfide

in shattered zones in granite also have been worked. Manganese-bearing outcrops are numerous in the limestone areas, but as a rule are rather small. The manganese ore occurs for the most part as pockety replacement bodies in the limestone at several horizons.

FREMONT DISTRICT

This district is described under Hidalgo County. In 1947, 129 tons of lead ore from the International mine was credited to Luna County by the U. S. Bureau of Mines in its Minerals Yearbook for that year.

LITTLE FLORIDA MOUNTAINS (MANGANESE VALLEY) DISTRICT

The Little Florida Mountains are a small range just north of the main Florida Mountains. They are composed chiefly of volcanic agglomerate. Important deposits of manganese have been developed and exploited during and since World War I. This district, together with the Lake Valley district, in Sierra County, accounted for most of the manganese produced in New Mexico prior to 1951.

The manganese deposits occur in an agglomerate on the east side of the range, along a strongly brecciated zone. The ore occurs chiefly as fissure and breccia filling and subordinately as a replacement of the associated rock.

The ore occurrences in the district are described more completely by Lasky (1940), and by Evans (1949).

TRES HERMANAS DISTRICT

The Tres Hermanas Mountains are about 25 miles south of Deming and 10 miles northwest of Columbus. The mineral deposits of the district have been known for many years, but no production of great importance has ever been attained. The value of production up to 1908 was estimated at possibly $200,000, chiefly in lead, gold, and silver. Oxidized zinc ore was discovered in 1904, and some of this was shipped in 1905.

The district was idle for many years, but there was a renewal of activity during the period 1933-1949. About one car of lead-silver-gold ore was shipped each year from 1934 to 1936. Six tons of high-grade ore was shipped from the Red Bird mine in 1940. All ore went to the El Paso smelter.

In 1943, 61 tons of high-grade zinc ore was shipped to the Ozark Pigment Co., at Coffeyville, Kansas. Again in 1947 and 1948 small shipments were made from the Calumet and other properties. In 1951 ore shipments were made from the Mahoney, Big Silver, and MeasdaySchoepf mines.

The Tres Hermanas Mountains consist largely of intrusive rocks flanked by small masses of Gym (Permian) limestone and later volcanics. Contact metamorphism is clearly evident. Garnet, diopside, and wollastonite are present in the metamorphosed sediments, and the rare

mineral spurrite also is present. The spurrite at this deposit was identified in 1928 by A. H. Koschmann.

The ore deposits consist of veins in rhyolite and intrusive porphyry and oxidized contact-metamorphic deposits in limestone. The veins contain ores of lead, silver, and gold. The contact-metamorphic deposits consist of oxidized ores of zinc containing lead and a little silver, and occur in part interbedded in the limestone and in part in crosscutting veins. The zinc minerals include smithsonite, calamine, hydrozincite, and the unusual anhydrous silicate willemite.

VICTORIO (GAGE) DISTRICT

The Victorio Mountains are in west central Luna County, about 3 miles from Gage, a station on the Southern Pacific Railroad about 19 miles west of Deming. The greatest activity in the district was from 1880 to 1886. Up to 1904 it produced oxidized argentiferous lead ore valued at $1,150,000. Almost the entire production came from two mines, the Chance and the Jessie. From 1904 to 1929 the district produced gold, silver, lead, copper, and zinc ore valued at $443,408.

There is no record of any production between 1929 and 1936. Ore was shipped from the Silver Branch Charm in 1936. In 1937 the Victorio mine shipped 1,009 tons of gold, silver, lead, iron, and lime ore to the El Paso smelter. Shipments of this type of ore were continued until May 10, 1940. The Victorio mine was developed by a 300-foot vertical shaft, 700 feet of adit, and over 40,000 feet of other workings. The mine was reopened in 1947, and the Carson Sanburg Mining Corp. shipped approximately 1,500 tons of zinc-lead-silver ore from the Victorio mine and two cars of ore from the Progresso Estrella group of claims. In 1948, 119 tons of ore from the Mahoney mine dump and a small amount of ore from the Victorio were sent to the El Paso smelter. No production has been reported since 1948.

The lead-silver-gold ores of the Victorio district occur in a detached limestone hill, known as Mine Hill, at the southeastern extremity of the Victorio Mountains. The main mass of these mountains consists of andesite and agglomerate flanked on the south by Paleozoic sediments. The rocks at Mine Hill are fine-grained dolomitic Montoya and Fusselman limestone. The ores occur in fairly distinct veins, which are generally tight, but which here and there widen abruptly into irregular bodies of galena in brecciated rock. The outcrops as a rule are inconspicuous. The ore is partly oxidized. The higher grade ores contained 15-22 percent lead, and some ores contained as much as 50 ounces of silver and 2 ounces of gold. All the ores contain arsenic.

A quartz-wolframite vein cuts the Montoya limestone in the main ridge. The vein is 1-5 feet wide. Small amounts of pyrite, galena, wulfenite, scheelite, and a little gold are also present. It is reported that the tungsten ore grades into copper ore at depth.

McKINLEY COUNTY

McKinley County is located in the northwest quarter of the State. It borders Arizona on the west and has an area of 5,456 square miles. The population is 26,920, about 40 percent being Navajo Indians. Gallup, located on the main line of the Santa Fe Railway, is the county seat.

The county long has been thought devoid of commercial metallic ore deposits, although some low-grade copper deposits in the Zuni Mountains are known. The recent discovery of extensive uranium deposits in the south central part of the county may change the picture entirely. The ore is found in the southern extension of the so-called Colorado Plateau region, and occurs in the Todilto limestones, the Morrison sandstones, and other formations. The minerals are chiefly carnotite, uranophane, and tyuyamunite, which contain small amounts of vanadium. The deposits are being explored by the Santa Fe Railway, on whose lands much of the mineralization occurs, the Anaconda Co., and many others. Ore production has been substantial, and appreciable reserves are reported as proven. The deposits extend into Valencia County.

MORA COUNTY

Mora County is in the northeastern part of New Mexico, between Colfax County on the north and San Miguel County on the south. It has an area of 1,942 square miles and a population of 8,604. Mora, a village of 1,400 people, is the county seat. The Santa Fe Railway passes through the county from north to south. Several paved highways serve the county.

COYOTE CREEK DISTRICT

The Coyote Creek mining district is situated in the valley of Coyote Creek, about 12 miles northeast of Mora and near the village of Guadalupita. Copper deposits occur in the red shales and red and gray sandstone on the west side of Coyote Creek. They are found for a distance of approximately 10 miles. The sandstone and shale beds, of the Dockum age, stand vertically, or nearly so, along the valley. The most highly mineralized member of this formation is greenish-gray shaly sandstone averaging about 6 feet thick.

The principal mineral is chalcocite, which has replaced plant remains and other organic material in the shale and sandstone. Chalcocite also occurs in small veinlets cutting across the beds.

There is no record of production from the district. Numerous pits, tunnels, and shallow shafts on the deposits attest, however, some mining activity. It is reported that one shipment of 40 tons of handsorted ore was sent to the El Paso smelter during World War I. The district has been inactive since that time.

Recently it has been discovered that uranium minerals occur with

the chalcocite. The U. S. Geological Survey and the U. S. Bureau of Mines have been cooperating with the Atomic Energy Commission in investigating the deposits as a source of uranium, with the recovery of copper as a byproduct.

OTHER DISTRICTS

The Rio la Casa district, about 9 miles west of Mora, covers an area of slight mineralization, in which much prospecting was done in the early days. The chief mineral sought was gold, which occurs in small, widely scattered veinlets of quartz in Precambrian rock. Some small specimens, very rich in gold, have been brought from the district. The workings in the district consist of small pits and open cuts. The ore was crushed and panned. No record of production is available. The district has not been active for many years.

The Rio la Casa placers are located just west of Mora, near the village of Cleveland, and close to the junction of Rio la Casa with the Mora River. The placer area was not large and was completely mined out in the early days. There is no record of production from this deposit. Reports of exceedingly rich pockets still circulate among oldtimers in the area. The gold undoubtedly came from the veinlets in the Rio la Casa district.

The Upper Rociada district, which is an extension of the San Miguel County district of the same name, is in the southwest corner of the county. The minerals of this district are contained for the most part in the pegmatite dikes, which are very numerous in that area. Some copper has been reported in the Precambrian schists.

The only known production from the district came in 1946, when a few carloads of lithium and tantalum ores were mined by Ted Chapman and associates. Other minerals occurring in the pegmatite are columbite and beryl. These have not been produced commercially.

Many occurrences of titanium-bearing ores have been reported from the county, but there is no reported commercial production.

OTERO COUNTY

Otero County is located in the south central part of the State, lying to the east of Dona Ana County and bordering Texas on the south. The county has an area of 6,638 square miles and a population of 14,709. Alamogordo, on the Southern Pacific Railroad, is the county seat. The western part of the county is covered by the sands of the Tularosa Valley, much of the area being occupied by the famous "White Sands." The Jarilla Hills rise abruptly from the valley. The foothills of the Organ Mountains lie to the west and southwest, and the Hueco and Cornudas Hills are in the extreme south, extending into Texas. The Sacramento Mountains occupy the east and northeast portion of the county, and the Guadalupe Mountains are in the southeast. All the

mountains and ranges of hills rim the huge Tularosa Basin, which is occupied at the present time largely by military reservations.

Otero County has only three recognized mining districts. Copper, gold, and iron have been mined in the Orogrande (Jarilla) district, copper from sandstone in the Tularosa district, and copper and lead from sandstone in the Sacramento Mountains. Most of the ore mined has come from the Jarilla Hills. Production from 1904 to 1930 had a value of $1,683,105; from 1930 to 1949 the value was $82,141.

OROGRANDE (JARILLA, SILVER HILL, BRICE) DISTRICT

Orogrande is a station on the Southern Pacific Railroad, in southwestern Otero County. The Jarilla Hills are a few miles northwest.

TABLE 15. PRODUCTION OF METALS IN OTERO COUNTY, 1904-1954

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc† (pounds)	Total Value
1904	$ 2,619	164	14,400	-	-	$ 4,586
1905-1909	53,258	7,141	1,596,509	-	-	322,742
1910-1914	119,284	16,717	1,398,422	10,723	-	333,759
1915-1919	124,226	21,200	3,123,255	31,299	-	869,530
1920-1924	5,617	774	9,481	325,229	-	31,587
1925-1929	12,580	2,819	262,555	708,126	-	101,892
1930	405	426	32,000	285,600	-	19,009
1931-1932*	-	-	-	-	-	-
1933	4,081	20	-	-	-	4,088
1934	4,541	11	-	-	-	4,548
1935	9,054	18	-	-	-	9,067
1936	3,297	9	-	-	-	3,304
1937	2,324	13	-	-	-	2,334
1938	406	1	-	-	-	407
1939	315	87	6,600	100	-	1,065
1940	1.015	211	16.000	1,700	-	3.058
1941†	-	-	-	-	-	-
1942	-	10	1,400	4,000	-	444
1943†	-	-	-	-	-	-
1944†	-	-	-	-	-	-
1945	-	10	2,000	-	-	277
1946	-	11	4,000	-	-	657
1947	700	313	46,000	206,000	-	40,307
1948	-	72	20,000	38,000	-	11,207
1949	-	-	-	10,000	-	1,580
1950	-	9	2,000	48,000	-	6,904
1951-1954†	-	-	-	-	-	-
Totals	$343,695	50,036	6,534,622	1,668,777	-	$1,772,352

* Figures not available.

† No production reported.

Prospecting first was begun in the Jarilla Hills in 1879, but no real mining was done until about 20 years later. A 250-ton matte furnace was operated at Orogrande from 1907 to 1909. Iron ore from the Cinco

de Mayo, Iron Duke, Lincoln, Seven Come Eleven, and Three Bears claims was shipped to Pueblo, Colorado, intermittently from 1916 to 1921. A jigging plant for treating these ores was operated in 1921. Up to 1904 the district yielded approximately $100,000 in gold and copper. Of this amount about $8,000 came from dry placer operations.

The district was active from 1933 to 1940 inclusive and again in 1947. The inactive periods 1941-1946 and 1948-1949 were due to several causes, shortage of manpower, the "gold order" of 1942, and the price of metals as compared with the high cost of production. In 1933 all production came from placer mines, Center, Little Joe, Cotton Top, and Orogrande being the chief producers. In 1934 the Flying Eagle lode produced 340 tons of high-grade lead-silver-gold ore.

Production in 1935-1938 all came from small placer deposits. In 1939 and 1940 there was some production from the two lode mines, the Flying Eagle and the Garnet. Three or four small prospects in addition to the placer workings also were producing during this period. Approximately 1,000 tons of lead-silver-gold ore was produced from the By Chance, Delusion, Crown Point, and Providence claims in 1947, but the whole district became idle at the end of that year, and has remained so to date. A small amount of tungsten ore was produced from the district in the early days.

The Jarilla Hills consist of an irregular mass of fine-grained monzonite porphyry, which has intruded carboniferous limestone. The limestone is metamorphosed near the contact and contains iron oxides and typical contact silicates. The ores occur as contact-metamorphic deposits in the limestone and follow bedding planes and fracture zones across the strata. They contain pyrite, chalcopyrite, galena, gold, and silver. Quartz-pyrite veins with indefinite boundaries are typical of deposits in the metamorphic rocks. The ores are partly oxidized.

Placer deposits, the gold of which was derived from some of the lode deposits, have been worked on the southeastern slopes of the hills. The gravels are reported to assay about $1.00 per cubic yard. Water is very scarce, most of the gold having been recovered with some form of dry washer. The gold is about 940 fine.

SACRAMENTO (HIGH ROLLS) DISTRICT

The Sacramento district is in the Sacramento Mountains, east of Alamogordo, and includes an area about 6 miles long between Alamogordo and Cloudcroft. The shipping point is La Luz on the Southern Pacific Railroad, 5 miles north of Alamogordo. It is estimated that about 1.6 million pounds of lead and 100,000 pounds of copper were produced to 1932. Most of the production immediately prior to 1932 came from the Stewart and Holmes property.

The district was active in 1933, 1939, 1940, 1942, and during the period 1945-1949 inclusive. A small amount of gold ore which went to the El Paso smelter was produced in 1933. In 1939 there were small

shipments of copper-silver ore from the La Luz No. 1 claim and about 20 tons of copper-lead-silver ore from High Rolls. The district shipped 20 tons of copper-silver ore in 1940, and in 1945 the Courtney mine, near High Rolls, shipped 59 tons of copper-silver ore. In 1946, 4,000 pounds of copper and 11 ounces of silver were recovered from this same mine. In the same year the Warnock and Courtney mine produced 2,055 tons of lead-copper ore. The district was idle in 1947, but in 1948, 644 tons of copper-lead ore was shipped to El Paso. Production dropped to 46 tons in 1949.

An extensive diamond-drilling program in 1947 and 1948 apparently failed to disclose substantial ore bodies.

The ores occur chiefly as disseminations of chalcocite and galena in Abo (Permian) arkose and grit. Minute amounts of chalcopyrite and bornite are present locally. Copper carbonate and nodules of chalcocite occur in some of the interbedded shales. In places the sulfides have replaced the cement of the rock completely, and the ore consists of grains of quartz and feldspar in a matrix of chalcocite or galena. Carbonaceous matter is scarce and bears no obvious relationship to the sulfides. The lead and copper ores occur in separate bodies; each is said to contain about 8 percent of either lead or copper. The silver content is very low.

TULAROSA (BENT) DISTRICT

The Tularosa district is near the southwestern base of the Sierra Blanca. The mines are in the vicinity of Bent, a camp about 10 miles northeast of Tularosa. Development of the mines began in 1904, and operations were essentially continuous until 1917.

The country rock of the Tularosa district consists of Pennsylvanian and Permian sediments, which have been arched near the mines by a mass of diorite porphyry.

The ores occur as disseminated particles in sandstone and in veins in the diorite porphyry and limestone. According to Darton (1928-b) the camp of Bent is situated in an area of Chupadera limestone. The deposits presumably occur in the sandy beds of this formation.

The ores in the sandstone are in general of the Red Beds type. Malachite, azurite, and chalcocite are disseminated through certain parts of the rock and along the cross fractures. Scattered grains of pyrite and chalcopyrite are present. The known ores are not far distant from the diorite porphyry outcrop.

The diorite porphyry and limestone are cut by veinlets and stringers of quartz, dolomite, and barite that contain a moderate amount of chalcocite and very little pyrite and chalcopyrite. A little chalcocite is disseminated in the porphyry between the stringers. The ores contain some silver and a little gold, in addition to the copper.

Production figures for the district are not available. Because of the low metal content, the actual amount of metal produced cannot have

been great, in spite of the apparently large tonnages of ore removed. There has been no reported production from the district in recent years.

QUAY COUNTY

Quay County is at the eastern edge of New Mexico. It has an area of 2,883 square miles and a population of 13,912. Tucumcari, located on the Southern Pacific and the Rock Island railroads, is the largest town and the county seat.

No metallic mineral production ever has been reported from this county, although some Red Bed copper deposits have been noted and prospected to a limited extent near Logan, on the Canadian River, northeast of Tucumcari. These deposits are similar to those found in the Pastura district of Guadalupe County, some 70 miles to the west, but the mineralization is much weaker.

Uranium ores have been found in the vicinity of Tucumcari and to the east and north. No production has come from the county as yet.

RIO ARRIBA COUNTY

Rio Arriba County covers an area of 5,855 square miles in the northwest quarter of the State. It borders the State of Colorado on the north, San Juan County on the west, and Taos County on the east. The county has a population of 24,543. Espanola, located in the Rio Grande Valley 25 miles north of Santa Fe, is the principal town, and Tierra Amarilla is the county seat.

Several small mountain ranges, some with peaks reaching elevations of 10,000 feet and more, emphasize the ruggedness of the central and eastern parts of the county. The metalliferous deposits lie within these mountainous areas, where rocks ranging from Precambrian to Tertiary in age are exposed. The western portion of the county belongs to the Plateau province and is underlain by flat-lying sedimentary rocks of Tertiary and Cretaceous age, which contain large coal deposits and some gas and oil.

Rio Arriba County has been noted more for its livestock industry than for its mineral production. Production from the county has not been large, and few deposits of economic importance have been found. However, metallic minerals to the value of about $500,000 have been recovered from its mountains. Currently, moreover, much interest is being shown in the possible recovery of the ores of beryllium, columbium, and the rare-earth metals cerium and thorium from the numerous pegmatites in the Petaca and Picuris regions. Since 1904 overall production has not exceeded $50,000 in value.

ABIQUIU DISTRICT

Abiquiu is on the Rio Chama, about 25 miles northeast of Espanola and 50 miles from Santa Fe, the nearest railroad point. The deposits

of this district probably are not extensive and have not been profitable to operate. They are chiefly copper deposits of the Red Bed type and low-grade placer deposits.

BROMIDE-HOPEWELL (HEADSTONE) DISTRICT

The Bromide district is located about 10 miles west-northwest of Tres Piedras, a small community 24 miles south of the Colorado state line, on paved highway 285. Ore was discovered in 1881, but the district never attained great importance. Total production, principally in copper and gold, did not exceed $50,000.

The ore deposits occur in Precambrian amphibolite schist and are believed to be of Precambrian age. They consist of lenticular quartz-pyrite veins and impregnations of sulfides along certain zones in the schist. The sulfide minerals are chiefly auriferous pyrite and chalcopyrite. Galena, sphalerite, tetrahedrite, molybdenite, magnetite, and specularite are present locally. Garnet, epidote, hornblende, and tourmaline occur in the wall rock. The deposits generally have a low gold content; some contain a moderate amount of silver.

The district has been idle for many years, although occasional interest has been shown in some of the deposits by prospective investors or promoters.

The Hopewell district is a westward extension of the Bromide district. The ore bodies of the two districts are similar in most respects. The principal difference is in the kind and relative amounts of metals present. In the Hopewell district gold has been the chief metal recovered, copper and silver being subordinate. Pyrite is more abundant, and chalcopyrite less so, than in the Bromide district. Some native gold has been found in the oxidized ores. The ores range widely in value.

A deposit of iron ore, consisting mostly of magnetite, was opened in the Precambrian schist, and rich gold placer deposits were worked in the western part of the district. The district first received attention as a result of the discovery of the placer deposits, which are said to have yielded $175,000 in the first 3 years. The value of the total output of the district was probably about $300,000.

Sporadic attempts have been made since 1930 to revive the district, the most noted effort being that of the Amarillo Gold Mining Co., which came into the area in 1938, built a mill, and treated several hundred tons of ore late that year and in 1939. Small amounts of gold were recovered from the placers, and a few tons of gold ore were shipped to the Golden Cycle mill at Colorado Springs each year from 1931 to 1940.

A small amount of core drilling was done in the district in 1948 or 1949, but no ore bodies of importance were encountered. Interest in the district continues, but presently no organized effort is being made to explore the deposits further.

EL RITO PLACER DISTRICT

The so-called El Rito district is north of the town of El Rito, in the Chama Basin. It lies largely between El Rito Creek and the Arroyo Seco.

The gold-bearing material of the district consists of conglomerate and minor sandstone beds of the Santa Fe (Tertiary) formation. The series attains a maximum thickness of 1,000 feet and is hundreds of feet thick over much of the El Rito area. The conglomerate is well cemented, and much of it is colored red by iron oxides. Gold is distributed sparingly through parts of the conglomerate in the fine-grained matrix. The material contains only about 10 cents a ton in gold and a trace of silver. It is so well cemented that blasting, crushing, and grinding would be required to release the gold. The deposits appear to have little commercial value.

GALLINA (COYOTE-YOUNGSVILLE) DISTRICT

The Gallina district includes a number of widely scattered prospects which occur in a large area in the vicinity of Gallina, a small village near the north end of the Nacimiento Mountains. Low-grade copper deposits occur in a micaceous sandstone and conglomerate grit of Permian and Triassic age. The ore consists principally of copper carbonates scattered through the rock in irregular bodies, thin sheets, and stringers. A few thin seams of bornite are present. Occasionally small amounts of chalcocite also are found. Barite is present locally.

A shipment of lead ore was reported from this district in the early days. The United States Geological Survey also noted a shipment of copper-silver ore in 1916.

NACIMIENTO MOUNTAINS (CUBA) DISTRICT

See Sandoval County.

PETACA DISTRICT

The Petaca district lies in the east central part of the county. The rocks of the district are Precambrian quartz-mica schists, which enclose a large group of pegmatite dikes. Some radioactive minerals, chiefly monazite and monazite sands, have been noted. Several hundred pounds of columbite was shipped from the district by Philip S. Hoyt in 1931, and Martinez and Slater shipped 1,550 pounds of ore in 1953-1954.

RINCONADA (WEST PICURIS) DISTRICT

This district is really the western tip of the Picuris district of Taos County. Wolframite, associated with tourmaline, quartz, and copper minerals, occurs in a pegmatitic vein near Rinconada.

No production has been reported from this district.

ROOSEVELT COUNTY

Roosevelt County is in eastern New Mexico. Its eastern border is the Texas state line. The county has an area of 2,455 square miles and a population of 16,391. Portales, an agricultural center, is the county seat.

No metallic mineral production ever has been reported from Roosevelt County, and no indications of metallic mineral deposits have been noted.

SANDOVAL COUNTY

Sandoval County covers an area of 3,717 square miles in north central New Mexico. Bernalillo County lies to the south and Rio Arriba County to the north. The Rio Grande cuts across the southeast portion of the county. The population of Sandoval County is 13,898. Bernalillo, the largest town, is the county seat.

The known metalliferous deposits occur in the central and eastern parts of the county, chiefly in the Nacimiento and Jemez Mountains. The Nacimiento Range is an overthrust block (Renick, 1931) about 30 miles long in the central part of the county, extending northward into Rio Arriba County. Precambrian granite is exposed on its steep western scarp. The Jemez (or Valle) Mountains are in the northeastern part of the county and are composed largely of volcanic rocks. The east and south fringes of these mountains are marked by huge lava flows, and deep canyons cut through the volcanic flow rocks.

The production of metallic ores from this county has not been great in recent years. The total output since 1904 is valued at less than $150,000. Ores of copper, gold, silver, and lead have been produced. The chief values have been in gold.

COCHITI (BLAND) DISTRICT

The Cochiti district is in the southern foothills of the Jemez Mountains. The town of Bland, now deserted, was the principal camp of the district. It is located about 30 miles west-northwest of Santa Fe.

Production from this district began in 1894 and amounted to slightly over $1 million by the end of 1904. After 1904 production declined rapidly and ceased entirely within a few years. The district was revived in 1914, when a mill was constructed and operated during part of that year. It was productive for short periods in 1915 and 1916. With the exception of short periods of minor activity, about the only work done in the district between 1916 and 1946 was assessment work. A few tons of silver and gold ore were shipped each year from 1931 to 1934, and in 1946 and 1947. In 1946 a new attempt was made to revive the district. A mill was built and a small amount of ore processed, but the operation was unsuccessful. At the present time some interest is being shown in

the area because of the reported occurrence of uranium mineralization in the vicinity of the Bland mine.

The principal rocks of the Cochiti district are rhyolite flows. The underlying monzonite is exposed in a canyon in the vicinity of Bland. The ores seem to have been confined to the monzonite and nowhere are known to extend into the overlying rhyolite. The ore bodies consist of quartz veins and lodes in a complex system of fractures and breccia and as replacement of the walls. Replacement ore rarely extends more than 10 feet from the open channels or fractures and usually is of lower grade than that occurring in the channel filling. Some of the ore bodies are wide but of low grade. The value of the ore decreases with depth, becoming economically worthless at about 600 feet. Small, rich pockets were found frequently.

The principal metals recovered were gold and silver, the chief ore mineral being finely divided argentite. Sphalerite and pyrite were the most abundant sulfides; galena and chalcopyrite occurred sparingly. None of these sulfides was sufficiently abundant to be of economic importance. Oxides of vanadium and uranium are reported as forming the cementing material in a silicified volcanic breccia at one place.

JEMEZ SPRINGS DISTRICT

Jemez Springs lies in the valley between the Nacimiento and the Jemez Mountains and is about 15 miles west-northwest of Bland and the Cochiti district. The district is not old, and ore bodies of importance have not yet been discovered. The ores are siliceous sulfides of copper, containing some gold and silver.

Several cars of ore were shipped from the district to the El Paso smelter in 1929, and in 1937 the Burnett Mining Co. shipped a car of ore from the Spanish Queen group of claims. No production has been reported from the district since that time.

NACIMIENTO MOUNTAINS (CUBA) DISTRICT

The copper deposits of the Nacimiento Mountains occur in Permian and Triassic Red Beds which consist of sandstone, marl, conglomerate, and shale. The principal ore mineral is chalcocite, although considerable bornite, azurite, malachite, and chrysocolla also are present. Some of the ore minerals are finely disseminated through the rocks, but generally they are associated with wood and plant remains which have been wholly or partly replaced by the copper minerals.

These deposits were discovered originally by Indians and Mexicans early in the last century. An effort was made systematically to mine the deposits in the 1880's, but lack of continuity of the ore made operations difficult. All ore mined in the early days was smelted locally.

Only very limited production has come from the district since 1900.

Some interest is being shown in the district at the present time. The possibility of reworking the old dumps is being investigated. Production from the district has amounted to about $700,000.

PLACITAS DISTRICT

The Placitas district is located at the north end of the Sandia Mountains, just east of the Rio Grande. It is an extension of the Tijeras Canyon district of Bernalillo County. Activity in the district has not advanced beyond the prospect stage.

The mineralization discovered so far occurs in veins and lodes. The ore metals are copper, lead, and silver. Small gold placers have been worked in the Placitas-Tijon region at the north end of the Sandia Mountains.

SAN JUAN COUNTY

San Juan is the most northwesterly county of the State. It covers an area of 5,515 square miles, more than half of which is Navajo Indian land. The county has a population of 18,113. Aztec is the county seat.

The entire county is underlain by coal beds, and the largest gas fields of the State are located in the San Juan basin, but the area has never been considered favorable for metallic mineral occurrence. Small amounts of silver and gold were recovered from the gravels of the San Juan, Animas, and La Plata Rivers in the early days. No production of importance, however, was attained.

The growing importance of uranium has extended the search for uraniferous ores over the entire Colorado Plateau area. Some deposits of carnotite ore have been discovered in the Morrison and other sandstones west of Shiprock. A considerable tonnage has been mined during the past 2 years and shipped by truck to Durango, Colorado, for processing. This ore contains appreciable amounts of vanadium. Production figures are not available.

A large mill for processing uranium ores has been built at Shiprock by the Kerr-McGee Uranium Co. This plant began operating in November 1954.

SAN MIGUEL COUNTY

San Miguel County occupies an area of 4,749 square miles in the northeastern quarter of the State. It has a population of 26,411. Las Vegas, the largest town, is the county seat. The northwestern portion of the county, in which Precambrian, Pennsylvanian, and Permian rocks are exposed, lies in the Rocky Mountain province. The rest of the county lies in the Great Plains province and is covered chiefly by Triassic and Cretaceous strata.

Known metallic mineral deposits other than those of uranium are

confined to the mountain area. Most of them are believed to be of Precambrian age. The deposit at the Pecos mine of the American Metal Co., located at the confluence of Willow Creek with the Pecos River, was one of the most important in the State. Before this deposit was brought into production in 1927, the value of ores and minerals recovered in the county was negligible. The Pecos mine operated from 1927 to May 29, 1939, and produced over 5 milllion tons of zinc-lead-copper and gold-silver ore valued at about $40 million. A small amount of oxidized surface ore was shipped from this deposit during World War II, but no attempt was made to reopen the mine.

EL PORVENIR (HERMIT MOUNTAIN) DISTRICT

The El Porvenir district is located in the Gallinas-Holinger Canyon country, some 14 miles northwest of Las Vegas. It is an area of much scattered mineralization, but no important deposits have been developed. The chief mineral sought by the early prospectors was gold, but showings of lead, zinc, copper, and molybdenum are numerous.

A deposit of molybdenite in a pegmatitic gangue of quartz, feldspar, and fluorite was opened up on the Bert Hoover Mining Lode No. 1 by a vertical shaft 75 feet deep and a 600-foot tunnel driven in from a side canyon. The deposit is in a saddle high on the south side of Hermit Mountain. The molybdenite occurs in small scattered pockets and blebs and is associated closely with chalcopyrite. Other associated minerals are scheelite, bismuthinite, and malachite. No production of ore is recorded from this district.

ROCIADA DISTRICT

Rociada is located in the foothills of the Sangre de Cristo Mountains in northwestern San Miguel County, only a short distance from the Mora County line. Mineral deposits were discovered in the area in 1900, but only a small amount of development was attempted prior to 1930. During the 1930's considerable work was done by Dr. W. G. Smith, of Tererro, New Mexico, on the more promising copper showings, but no ore bodies of commercial grade were uncovered.

Most of the deposits are of Precambrian age and consist of fillings in small fissure veins in the ancient gneisses and schists. Some disseminated copper carbonates, accompanied by a little chalcocite, occur locally in the basal carboniferous grit. The Precambrian quartz veins contain gold, silver, and various copper minerals, as well as lead and zinc. The veins are generally parallel to the foliation of the country rock. The wall rock commonly is altered, and contact-metamorphic minerals occur locally. The lithium ores lepidolite and spodumene are found in some of the pegmatites in the district. These ores usually carry small amounts of microlite. A small production of these ores was obtained in 1945-1946.

TECOLOTE DISTRICT

The Tecolote district occupies a large portion of the country southwest of Tecolote Mountain, a prominent butte 6 miles south and west of Las Vegas. The district includes the Tecolote, Salitre, San Pablo, Mineral Hill, and San Miguel subdistricts. The principal mineral that occurs in these subdistricts is copper. Attempts at mining were made about 1900, and about 5,000 pounds of copper was produced from a local leaching plant. The district is considered of minor importance, and no attempt has been made to develop it in recent years.

The surface rocks of the district are strata of Permian and Pennsylvanian age, under which are Precambrian gneisses and schists. The mineral deposits consist of copper minerals disseminated through certain beds. These minerals are chalcocite, bornite, chalcopyrite, and their oxidation minerals, malachite and azurite. The sulfides have replaced the carbonate cement of arkosic sandstone and to some extent the kaolinized feldspar grains. In some places the copper is fairly evenly distributed through the rock, but more commonly it is confined to narrow bands parallel to the bedding.

WILLOW CREEK (PECOS, COOPER) DISTRICT

This district is located on the east side of the Pecos River Canyon at the mouth of Willow Creek, some 14 miles north of the town of Pecos. Until quite recently, the district was known as the Pecos (or Cooper) district, and all the patented mineral ground is described in the surveys and records as being in the Pecos (or Cooper) district. There is a much older Willow Creek district in Colfax County.

The importance of this district was due entirely to the operations of the Americal Metal Co. of New Mexico at the Pecos mine, one of the most important mines of the State during its life — 1927 to 1939. Tererro, a town of some 3,000 people at the peak of its existence, was the mine camp, built by the company. It was located in the Pecos River Canyon, adjacent to the mine. Glorieta, a station on the main line of the Atchison, Topeka & Santa Fe Railway, was the nearest railhead. The concentrating plant, a 600-ton selective-flotation mill, was located at Alamitos, a small community in a semienclosed canyon, about 6 miles northeast of Glorieta and 12 air miles from the mine. The mill was not located at or near the mine, because of the lack of suitable ground and space for the disposal of tailings and the impracticability of constructing a railroad through the canyon to serve the mill. A 4-mile branch road was built from the main line of the Santa Fe to the mill at a reasonable cost. Ore was transported from the mine to the mill by an aerial tramway 12 miles long, which crossed canyons and mountains in a direct line between the two operations.

The Pecos mine deposits were located first in 1882 and were originally known as the Hamilton (or Cowles) mine of the Pecos River Mining Co. Small amounts of high-grade copper ore from near the surface

were hauled by wagon to Glorieta for shipment to the El Paso smelter. This project was unprofitable and soon abandoned. Development work was intermittent until 1916, when the property was acquired by the Goodrich-Lockhart Co. An extensive program of prospecting and development was interrupted by World War I; after the war, work was resumed. Much core drilling and underground development was done, resulting in the proving up of several million tons of ore.

The American Metal Co., Ltd., of New York, took the property over in 1926 and organized the American Metal Company of New Mexico to operate it. The mine was placed in production in January 1927 and continued as a large producer of zinc, lead, copper, gold, and silver until May 29, 1939, when ore reserves of minable grade were depleted. The mining operations were very expensive, owing to heavy ground and excessive water. At the close of operations it was determined that an average of over 14 tons of water had been pumped for every ton of ore recovered, and that the average timber consumption had been over 6 million board feet per year. The operation was not very profitable for the company, because of abnormally low metal prices during most of the life of the mine and the high costs of production.

The ore deposits occurred in a highly sheared zone of a Precambrian diabase mass. The Precambrian rocks in the area are exposed only in the Pecos River Canyon and the canyons of its tributaries where the streams have cut through the overlying beds of limestone and arkose. At only a few places did the ore bodies reach the overlying sedimentary rocks, and nowhere did they extend into them, although in one stope the ore had a width of over 30 feet where it came against the overlying arkose. The predominant Precambrian rock of the area is granite, but large blocks or masses of diabase occur. Both rocks have been faulted and sheared, resulting in large zones of schistose material. The diabase is metamorphosed to chlorite and garnetiferous amphibolite schists, and the granite to quartz-sericite schist. A strong east-west premineral fault lies just north of the ore bodies, and the ore faded out in the debris of this fault zone. Some evidence of slight postmineral movement was found in the zone and in the ore bodies near the zone. No mineralization was found north of the "Big Fault."

Two main ore bodies were worked in the mine, one overlapping the other. About 60 feet apart at the extreme interval, they approached each other toward their ends and were joined as they entered the "Big Fault" zone.

The total depth of the mine was 1,750 feet. Little commercial ore was found below the 1,200-foot level, and none was mined below 1,350 feet. The ore was a complex and intimate mixture of sphalerite, galena, chalcopyrite, gold, silver, and pyrite. Minor quantities of pyrrhotite, tetrahedrite, bornite, argentite, and pyrolusite were identified. The gangue consisted of quartz, tourmaline, minerals of the schists, and a very small amount of fluorite. The depth of oxidation is shallow; sec-

ondary chalcocite enrichment was noted in places, and a few fragments of native copper were found. Oxides of lead, zinc, and copper occurred in small amounts near the north end of the deposits.

With the closing of the Pecos mine in 1939, San Miguel County lost its place as a major producer of metals. It is probable that new discoveries will be made, and the county again may become an important producer of metals. The Sangre de Cristo Mountains surely hold other deposits similar to those of the Pecos mine.

SANTA FE COUNTY

Santa Fe County is in north central New Mexico between Sandoval County on the west and San Miguel County on the east. It occupies a rectangular area of 1,927 square miles and has a population of 37,582 (1950). Santa Fe, the State capital, is also the county seat.

The principal mineral deposits are contained in groups of hills near the western boundary, named from north to south the Cerrillos Hills, Ortiz Mountains, and San Pedro Mountains. These hills consist of laccolithic intrusions into Carboniferous and Cretaceous strata. Placer gold deposits in this area were important at one time. From 1904 to 1930 mines in Santa Fe County produced gold, silver, copper, lead, and zinc valued at almost $3 million, about 90 percent of which was derived from the deposits of the New Placers district. From 1930 to 1954 the mines produced ore valued at $1,075,592, of which about 75 percent came from the San Pedro mines.

A plant for the production of zinc oxide from carbonate ores was built by the Grubnau Chemical Co. at Waldo, on the main line of the Atchison, Topeka & Santa Fe Railway, in 1917. It operated intermittently from 1917 to 1922. Part of the ore treated came from Mexico. Toward the end of World War II, a mill was built in the Los Cerrillos district by the Moline Mine and Milling Co. to concentrate lead-zinc ores. This mill treated small amounts of ore in 1945 and 1946.

The Raskob Mining Interests, Inc., acquired the San Pedro mine near Golden in 1938. The peak of production from this mine was attained in 1940.

Gold, in small amounts, was recovered from placer and lode deposits in the Ortiz and San Pedro districts each year between 1930 and 1953.

CERRILLOS DISTRICT

The Cerrillos Hills are a few miles north of Cerrillos. a station on the Santa Fe Ry. Ore was discovered in the district in 1879, but some mining may have been done by the Indians and Spaniards at a much earlier date. The district has been active in varying degrees most of the time since its discovery. Official production statistics included production of this district with that of the Ortiz (Old Placers) district until 1930. It is estimated that the value of ores recovered from the Cerrillos

TABLE 16. PRODUCTION OF METALS IN SANTA FE COUNTY, 1904-1954

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total Value
Prior to 1904	-	-	-	-	-	$3,500,000†
1904-1930	$282,806	253,392	9,829,155	4,581,548	5,202,482	2,992,629
1931-1932*	-	-	-	-	-	-
1933	6,904	49	1,000	-	-	6,985
1934	8,193	99	700	5,000	-	8,498
1935	7,035	182	11,000	100	-	8,083
1936	6,398	62	3,500	-	-	6,768
1937	8,659	1,781	87,000	700	-	20,605
1938	11,242	2,718	88,800	39,400	-	23,513
1939	53,200	8,881	671,200	200	-	129,042
1940	109,060	32,597	2,789,000	-	-	447,397
1941	40,495	17,384	1,437,000	-	-	222,423
1942	9,555	242	300	11,800	14,000	11,856
1943	1,575	557	800	32,000	46,000	9,443
1944	105	599	1,200	37,800	57,000	10,215
1945	490	1,789	2,000	102,000	120,000	24,604
1946	2,030	2,016	6,000	140,000	79,000	29,529
1947	1,015	13	500	-	-	1,132
1948	1,505	1,139	2,000	58,000	38,000	18,406
1949	735	938	16,000	30,000	14,000	13,325
1950	2,205	643	46,000	-	-	12,355
1951	1,750	853	8,000	58,000	76,000	28,324
1952	280	295	6,000	54,000	72,000	23,188
1953-1954‡	-	-	-	-	-	-
Totals	$555,183	326,229	15,007,155	5,150,548	5,718,482	$7,548,320

* Figures not available.

† Estimated.

‡ Production very small; not reported.

district amounted to $175,000 between 1904 and 1930. Very little production was obtained from the district between 1930 and 1940.

In 1942 the Cerrillos Lead and Zinc Co., operating the Pennsylvania and Tom Payne mines, produced a few cars of ore. All production went to the American Smelting & Refining Co.'s custom mill at Hanover, Grant County. The Tom Payne continued in small production in 1943 and 1944. In 1944 Franklin Mines, Inc., leased the Franklin and Cash Entry groups of claims and did considerable exploratory and development work, making tests of the ore in a small pilot mill. The Moline Mining and Milling Co. acquired these leases in 1945, producing ore from the Franklin, Cash Entry, and Chicago claims, and treating 1,500 tons of ore in its own mill on the property. In the same year the Cerrillos Lead and Zinc Co. shipped 291 tons of high-grade ore from the Pennsylvania and other claims to the Hanover custom mill. The Tom Payne also produced a small amount of ore in that year.

The Moline Mining and Milling Co. operated until August 1946, and produced 2,000 tons of ore from the Franklin group. The Cerrillos Lead and Zinc Co. operated the Pennsylvania group until August 15

of that year, producing 166 tons of high-grade ore. No production was reported from the district in 1947, but in 1948, 1,024 tons of ore was mined from the Cash Entry-Franklin group. In 1949 a few cars of ore were shipped from the district. Further small shipments were made in 1950-1951 and 1952.

The ores of the district are chiefly lead, zinc, and silver. Some gold has been recovered also.

The Cerrillos Hills consist of Cretaceous sandstone and shales, which are intruded by a laccolithic mass of monzonite. Numerous small, narrow veins containing lead, zinc, and silver occur in the main part of the monzonite; some of them cut across the contact into the surrounding Cretaceous rocks. Argentiferous galena, sphalerite, and a little chalcopyrite are the principal ore minerals. The prevailing gangue minerals are quartz and carbonates. Tourmaline is present at places, and wulfenite is reported. The upper parts of the veins are somewhat oxidized.

GLORIETA DISTRICT

The Glorieta district covers a large area in the vicinity of the village of Glorieta, a small community at the pass of the same name which divides the watersheds of the Rio Grande and the Pecos River. It is one of the highest points on the Santa Fe Ry. The mineral deposits of the district are of three types: the iron deposits, the copper deposits, in the Red Beds, and the vein deposits of copper, lead, and zinc minerals. The iron ore occurs near the rim of Glorieta Mesa, about 5 miles southwest of Glorieta, and consists of a dark-red, earthy hematite. The bed is 3-4 feet thick and occurs near the top of the Red Beds. Several thousand tons of fluxing ore were shipped to the El Paso and Socorro smelters prior to 1905, and some ore was shipped to the steel mills of the Colorado Fuel & Iron Co. at Pueblo, Colorado, during World War I. The ore is of such color and texture as to suggest its possible use as a pigment in paints or enamelware.

The Red Bed copper deposits occur on La Cueva Creek in what are probably upper Pennsylvanian strata. Chalcocite, azurite, and malachite occur in a coarse sandstone or arkose bed; also some chalcocite as grains in the overlying crinoidal limestone. The minerals seem to be most abundant where the rock contains the most organic remains.

The vein deposits occur in the Precambrian granite and diabase schist zones of the region north of Glorieta. Considerable work has been done to explore these deposits, but no commercial bodies of ore have been found.

LA BAJADA DISTRICT

The La Bajada district is 18 miles southwest of Santa Fe, in the La Majeda land grant. The copper deposits are exposed in the walls of a canyon on the old Santa Fe-Domingo highway. The La Bajada Cop-

per Mining Co. was organized in 1923 to develop the deposits, but very little work was done. Chalcocite, chalcopyrite, and oxidized copper minerals occur along a rhyolite-limestone contact and as disseminations in porphyry. In addition to copper, the ore contains some silver, a little gold, and traces of uranium. A small shipment of copper-silver ore was made in 1928.

NEW PLACERS (SAN PEDRO) DISTRICT

The New Placers (San Pedro) district, so named in contrast with the Old Placers district discovered a few years earlier and lying some miles to the north and east, was discovered in 1839. It is located in the San Pedro Mountains and has been one of the richest placer districts of the State. In addition, it contains important lode deposits of gold, copper, lead, and manganese ores. No figures on the early production from this district are available, but the total value was undoubtedly large. From 1904 to 1930 the production of gold, silver, copper, lead, and zinc had a value of $2,783,520, representing about 95 percent of the total production for the county during that period.

The San Pedro copper mine, one of the largest mines in the district, has been worked intermittently since 1889. A smelter, built near the mine in 1899, was operated at irregular intervals until 1918. The Carnahan Mines Co., operating several properties, including the Amazon, Anaconda, and the Lincoln-Lucky group, was the most important producer during the late twenties. It operated a selective-flotation mill on complex lead-zinc ores from 1925 to 1928 and shipped large quantities of lead-silver and zinc concentrates. The Santa Fe Gold & Copper Co. owned and operated the San Pedro during about the same period.

Records of operations in the district for 1931 and 1932 are not available. Since that time the records indicate continuous activity, although production for some years was quite small. Some production of gold ore was obtained from the Santa Fe mine each year from 1933 to 1936. Most of the ore was treated in a Huntington mill near the mine, but several carloads were shipped to the El Paso smelter. Production came mostly from small, high-grade quartz veins.

The San Pedro mine shipped ore to El Paso in 1937, as did the Old Timer, Delgado, and Vijely. The San Pedro was purchased by John J. Raskob interests in 1938, and an intensive exploratory and development program was undertaken. Some ore was shipped from this mine and from the Lincoln-Lucky-Amazon lease during the year. The Raskob Mining Interests, Inc., began building a flotation mill in 1939 and started processing ore late that year. This mill had a capacity of 150 tons per day and operated continuously until August 15, 1941. It treated about 60,000 tons of ore and produced approximately 6 million pounds of copper. Other properties producing intermittently in the district during this period were the Old Timer, Candelaria, Santa Fe, Live Oak, Mascot, and Shamrock. Some of these properties also operated at intervals until 1949. The Shamrock Gold Mining Co. operated a concentrat-

ing-amalgamation plant on ore from the Padilla mine for 2 weeks in 1946. About 100 tons of ore was treated. The San Pedro mine presently is owned by Col. C. F. Williams, of Santa Fe.

During the entire period 1931 to 1952, placer gold was being recovered in small amounts from the placers of the district. The most consistent producer was the Lazarus.

The San Pedro Mountains are largely the result of erosion of a granodiorite porphyry laccolith intruded into Pennsylvanian and Permian strata. Contact metamorphism of the sediments is pronounced, especially in the roof of the laccolith. Gold-bearing veins are abundant both in the porphyry and in the altered sediments. Contact-metamorphic copper deposits were formed in the limestone adjacent to the laccolith, and replacement deposits of galena and associated sulfides occur in the limestone farther away. Gold-bearing gravels have accumulated in the erosion debris at the foot of the hills.

The veins carry free gold and pyrite in a quartz-calcite gangue and consist of fracture zones and filled fissures, in which the gold is restricted to seams and stringers. They are very narrow, and the gold is distributed erratically. The depth of oxidation rarely exceeds 100 feet.

The contact-metamorphic copper deposits in limestone are confined to the lower part of the sedimentary rocks which form the roof of the laccolith. The limestone has been garnetized and recrystallized. Chalcopyrite is the chief ore mineral, and the ores contain a small amount of silver and gold. Oxidation is shallow.

The replacement deposits of galena, sphalerite, and associated sulfides occur as chimneys and irregular bodies in the limestone. Alabandite, the rare manganese sulfide, is reported to occur.

The placer gold is contained in detrital forms of subangular material at the foot of the San Pedro Mountains, particularly on the north, south, and west. A partial concentration of gold has taken place along the creeks and gulches that cut into the gravel beds. The gravels contain 20 cents or more in gold value per cubic yard, much higher values being found near bedrock. The overburden is 10-40 feet thick, and the gold is generally coarse and rough and is said to be 920 fine. Water for the treatment of the gravels is scarce. It can be obtained sometimes by drilling wells. Some of the deeper wells have yielded up to 25 gallons per minute.

OLD PLACERS (ORTIZ, DOLORES) DISTRICT

The Old Placers (Ortiz) district is in the Ortiz Mountains between the San Pedro Mountains and the Cerrillos Hills. The first gold found in New Mexico was in this district. The placer deposits were discovered in 1828, and the gold-quartz veins 5 years later. Placer production to 1904 probably amounted to $2 million, but no reliable estimate of lode production prior to that year has been noted. Combined production of the Old Placers and the Cerrillos districts from 1904 to 1928 is valued at $207,772. The Ortiz mine, in Cunningham Canyon, was the chief producer from lode deposits, and the largest ore shoot is said to have

been mined between 1854 and 1864. Much of the ore was treated by stamp mill.

The district was idle for several years. The American Metal Co. of New Mexico sampled the Cunningham Lode in 1936, and the Ortiz Mining Co. renovated the Ortiz mine shaft and shipped several cars of ore to El Paso that year. The Ortiz mine was acquired by the Santa Cruz Mining Co. in 1937. This company made extensive repairs to the shaft and underground workings, but there is no record of its having produced any ore. A small amount of ore was produced from the Cord mine in 1938. A small amount of gold was recovered from placer operations during the same year.

The Universal Placer Mining Co. leased the Ortiz placers in 1939 and operated a 21A-cubic-yard dragline that year and until April 22, 1940. The gold was recovered by a dry-separation process. A small amount of gold-copper ore was shipped from the district in 1941, and a few ounces of gold was recovered from placer deposits both in 1941 and in 1942.

Shortly after World War II, Potter and Sims Mining Co., from the Tri-State region, acquired the mineral rights on the entire Ortiz Grant. Since that time extensive prospecting and experimental work have been done on both the placer and lode deposits under the supervision of Mr. G. R. Griswold. No ore production has been reported.

The Ortiz Mountains are composed chiefly of laccolithic intrusions of diorite or monzonite porphyry. The intruded Cretaceous rocks are somewhat metamorphosed. The ore deposits are of three kinds: quartz veins, contact-metamorphic deposits, and placer deposits.

The placer deposits, from which the district takes its name, at one time constituted one of the most important sources of placer gold in the State. The placer gravels form a mesa which is the upper part of an old alluvial fan. They occupy a large area and increase in thickness with distance from the mountains. In places they are over 100 feet thick. The gold, some of which is coarse, is said to be 918 fine. Each cubic yard of gravel yields, in addition to the free gold recoverable by placer methods, from 3 to 75 pounds of "black sand" containing $4-$30 a ton in gold. Mining of these placer deposits has been handicapped severely by lack of water. There is not enough water available for wet methods of recovery, and the gravels are too damp for dry methods.

SANTA FE DISTRICT

The Santa Fe district comprises that portion of the Sangre de Cristo Range just east of the city of Santa Fe, including the areas in the vicinity of the Santa Fe River and Penacho Peak on the west side of the range, and the headwater areas of Dalton and Macho Creeks on the east side of the range. The rocks of the region are chiefly Precambrian granites, diabase, and schists.

No important ore bodies have been discovered in the district to date. A small amount of placer gold is reported along the upper reaches of

the Santa Fe River and its tributaries, but no production has been reported. In the Mikado subdistrict, on the south side of the Santa Fe River, gold-silver and copper mineralization occurs in fissures in aplitic gneiss and in schists. Galena and sphalerite are present locally. Small deposits of copper, carrying some gold, occur on Penacho Peak.

In the area on the east side of the range, around the head of Dalton, Macho, and Indian Creeks, strong mineralization occurs in the shear zones in the diabase and along the diabase granite contacts. No ore bodies of importance have been developed, but much interest has been shown in the district because of its geological similarity to the Pecos mines area, a few miles away. A few small pegmatite dikes in the Dalton Creek area contain columbite and monazite in small amounts.

SANTA FE MANGANESE DISTRICT

Manganese deposits have been found in sedimentary rocks in the foothills of the Sangre de Cristo Mountains, about 4 miles northeast of Santa Fe. The ore occurs largely as replacement bodies along the bedding planes in soft shale beds. It forms small irregular pockets; some of it has a nodular structure. Very little ore has been produced. Only in periods of national emergency, such as World Wars I and II, has any interest been shown in the district.

SIERRA COUNTY

Sierra County, in southwestern New Mexico, has an area of 4,159 square miles and a population of 7,174. Truth or Consequences, formerly Hot Springs, is the county seat. The Rio Grande traverses the eastern part of the county from north to south. Socorro County lies to the north, Dona Ana and Luna Counties to the south, and Grant County to the west. The narrow, longitudinal Fra Cristobal and Caballos mountain ranges lie directly east of the river and extend the entire length of the county. The crest of the Mimbres (Black) Range marks the boundary between Sierra and Grant Counties.

In January 1951 the long, narrow southward extension of eastern Socorro County was annexed to Sierra County. This area of approximately 1,125 square miles includes the northern part of the San Andres Mountains, which are continued to the northeast as the Oscura Mountains. This region also contains a large portion of that long, waterless section of country called by the Spaniards "Jornada del Muerto," and dreaded by the early caravans between Mexico City and Santa Fe because of its lack of water. No production from the mining districts in this "panhandle" area has been recorded since 1920. For statistical purposes it seems better to continue the listing of this area under Socorro County.

Sierra County was at one time one of the chief metal-producing counties of the State. The principal deposits were discovered in the late seventies and early eighties, in the period of great mining activity that

followed the construction of the railroads in the State. Kingston, Lake Valley, and Hillsboro were the most important districts. Prior to 1904 the Kingston district produced ore having a value of about $6,250,000, the Lake Valley district about $5,300,000, the Hillsboro district about $6,750,000, and the other districts about $1,500,000. The production of the county from 1904 to 1930, exclusive of manganese ores, was valued at $1,201,263, and values from 1931 to 1954 amounted to $1,210,364. During this period approximately 40,000 tons of manganese ore was produced, most of which was placed in the U. S. Government stockpile at Deming.

Detailed descriptions of the ore deposits of Sierra County are presented in a comprehensive report by G. T. Harley (1934).

TABLE 17. PRODUCTION OF METALS IN SIERRA COUNTY, 1904-1954

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total Value
Prior to 1904	-		-		-	$19,800,000*
1904-1930	$ 337,169	803,921	528,323	1,362,668	47,037	1,201,263
1931-1932†	-	-	-	-	-	-
1933	14,812	1,291	3,000	600	-	15,478
1934	66,217	10,115	15,200	3,400	-	74,098
1935	125,252	4,341	22,000	19,000	-	130,962
1936	157,451	4,341	22,000	19,000	-	170,004
1937	112,196	10,905	32,200	90,700	80,000	135,078
1938	91,392	9,283	17,400	42,100	35,000	102,715
1939	118,440	12,702	32,400	23,700	-	131,546
1940	104,195	22,649	35,300	56,400	-	127,110
1941	53,130	5,118	23,400	7,400	-	60,237
1942	21,420	1,139	3,600	14,000	12,000	24,720
1943	805	13,673	44,000	125,000	176,000	44,631
1944	700	11,807	30,000	101,000	131,000	36,160
1945	35	1,246	1,000	16,000	-	2,432
1946	820	1,135	1,000	6,000	-	2,013
1947	385	7,314	8,300	171,000	1,600	33,565
1948	455	7,689	16,000	144,000	-	36,662
1949	1,680	2,738	2,000	78,000	-	16,876
1950	4,340	1,033	4,000	8,000	-	7,187
1951‡	10,300	2,928	4,000	44,000	8,000	23,186
1952‡	4,795	5,001	2,000	32,000	48,000	22,925
1953‡	9,485	907	-	8,000	10,000	12,504
1954§	-	-	-	-	-	-
Totals	$1,235,474	947,875	863,123	2,365,668	548,637	$22,211,352

* Estimated.
† Figures not available.
‡ Figures unaffected by the annexation of territory from Socorro County in 1951.
§ No production except manganese.

CABALLO MOUNTAINS DISTRICT

The Caballo Mountains are on the east side of the Rio Grande, just south of Truth or Consequences (Hot Springs). The district, which

includes mines and prospects in all parts of the mountains, has never been a large producer of ores and has been practically inactive for many years. Small shipments of lead ore were made by F. J. Cox in 1937, and from the Adobe and Badger claims in 1948. A small amount of ore yielding 8 ounces of gold, 74 ounces of silver, 2,800 pounds of copper, and 8,000 pounds of lead was shipped from the Regina and Black Rock properties in 1951.

Prospecting for uranium ores has been active since 1950. A large number of claims have been staked. There is no record of production from the district.

The mountain range is a monoclinal block bounded on the west by a scarplike front showing exposures of Precambrian granite overlain by almost a complete succession of Paleozoic strata (Darton, 1928-a). The range is cut by a system of transverse fault fissures.

Copper deposits, which occur chiefly along the westward facing slope of the range south of Palomas, consist of bornite, chalcopyrite, and their oxidation productions in a quartz gangue. The deposits are small and occur mostly in the basal Cambrian quartzite just above the granite contact. Galena-fluorite-barite ore occurs in fissures in the overlying carboniferous limestone. The ores contain very little gold and silver.

Vanadinite and cuprodescloizite occur in some of the lead veins at and near Palomas Gap (Hess, 1913). Galena, cerussite, and copper carbonate are present; the gangue minerals are calcite, fluorite, barite, and quartz. Pyromorphite and wulfenite are present in some of the veins south of the vanadium-bearing area. A plant was erected at Cutter for making vanadium oxide and lead sulfate, but it operated only a short time.

Considerable fluorspar occurs in the Caballo Mountains region, but it is associated so intimately with barite that it has received little attention as a possible commercial source of this material.

CHLORIDE (APACHE, BLACK RANGE, CUCHILLO NEGRO) DISTRICT

The Chloride district is in the northwestern part of the county, on the east side of the Black Range. It includes the Apache, Cuchillo Negro, and Black Range subdistricts; all are along the east slope and in the foothills of the range. The town of Chloride is about 28 miles northwest of Truth or Consequences. Ore was discovered in the region in 1879, and some production has come from the district almost continuously to the present time. The value of production amounted to about $500,000 by 1930. Since 1930 total production has not exceeded $100,000 and has come from many small mines. The Great Republic mine produced the most ore, but the St. Cloud, Colossal, Fortuna, Ivanhoe, Vindicator, and many small prospects contributed to the overall production.

Several mining companies operated in the district intermittently during the period 1931-1949, notably the Nina Maria Mining Co., the Great Republic Mining Co., the Empire Mines & Metal Co., Andrew B.

Stewart & Associates, and the Deming Mining Co. All produced some ore from various properties. In 1950-1952 small shipments of ore were made from the Big Bug, Dobie, Minnehaha, Bald Eagle, and St. Cloud properties.

The rocks of the district consist of carboniferous strata partly covered by volcanic flows and locally intruded by monzonite porphyry. In the Black Range area the ores occur chiefly as vein deposits in the flow rocks and, in general, are of two kinds: gold-silver ores and copper ores. Most of the gold-bearing veins occur in a northward trending belt which follows approximately the contact between the limestone and the flow rocks. The veins are fairly persistent. The gold ores are free-milling and usually contain some sulfides. The gangue is made up of quartz and subordinate barite. The silver-copper ores occur west of the gold belt in nonpersistent shear zones which carry silver-bearing copper sulfides.

In the Sierra Cuchillo considerable copper ore has been mined from deposits of contact-metamorphic origin. Deposits of iron ore consisting of magnetite and hematite also have been found in the contact zones in garnetiferous rocks. Most of these deposits occur just over the county line to the north (see Iron Mountain district, Socorro County). Extensive prospecting has been done in search of replacement deposits in limestone, and promising evidence of such deposits along the monzonite contact on the east slope of the range has been noted. Prospecting has been carried on in the cassiterite-bearing, extrusive porphyries along the eastern and southern slopes of the Black Range.

DERRY MANGANESE DISTRICT

The Derry district (Wells, 1918) is on the west side of the Caballo Mountains, about 6 miles northeast of the town of Derry and 13 miles north of Hatch, a station on the Rincon-Deming branch of the Atchison, Topeka & Santa Fe Railway. The manganese ore occurs in fissures in limestone along the crest and limbs of a northward trending anticline. The ore consists of manganiferous and ferruginous calcite accompanied by secondary oxides of manganese and iron, and forms fissure fillings and replacements in bodies of fractured limestone.

Little production has been obtained from the district, although some development work was done during World War II.

FRA CRISTOBAL RANGE DISTRICT

The Fra Cristobal Range extends along the east side of the Rio Grande from near Truth or Consequences northward for about 25 miles. Numerous mineral deposits have been reported from these mountains, but the land lies mostly within the old, Spanish Pedro Armendaris Grant and is not open for mineral prospecting and development by others than the owners. It is reported that the latter are having their entire holdings mapped and examined for mineral deposits that may be of commercial value.

HERMOSA (PALOMAS) DISTRICT

The town of Hermosa is about 15 miles south of Chloride and 40 miles west of Engle, the nearest railroad station. It lies at the southern end of the Cuchillo Mountains. The district was the scene of great activity in the eighties and early nineties, but the mines were rapidly worked out, and there has been very little activity in the area since the turn of the century. Sporadic attempts have been made to reopen some of the mines, but no new ore discoveries of importance have been made in recent years. Production from the district prior to 1904 is said to have amounted to about $1,250,000. Production since that time has been slight.

In 1936 the Pelican group of claims produced 10 tons of high-grade lead-silver ore, and again in 1942 this group produced 6 tons of the same type of ore. The Yankee-Girl, Palomas Chief, and Wilford No. 1 produced a few tons of lead-silver ore in 1943 and 1944, and the Vulture produced a truckload, possibly 10 tons, in 1948. The Pelican group was worked by Ferguson and Jones in 1950-1951. In 1952 the district produced 1 ounce of gold, 2,898 ounces of silver, and 8,000 pounds of lead.

The rocks of the region consist of volcanic flows flanked on the east by a narrow band of sedimentary rocks which have been exposed by faulting and erosion of the overlying flow rocks. The ore deposits occur just below a shale bed along a flat arch in lower Magdalena limestone. They form irregular pockets, lenses, and pipes along the intersections of certain fractures. The ores are silver-bearing sulfides of lead, copper, and iron in a gangue of talcose clay. Native silver is common, but in the high-grade ore, which runs as much as 700 ounces of silver per ton, the silver is contained in argentiferous galena and bornite.

HILLSBORO (LAS ANIMAS) DISTRICT

The district takes its name from the town of Hillsboro located on State Highway 180, 15 miles south and 18 miles west of Truth or Consequences. Lying in the foothills of the Black Range, Hillsboro is the center of one of the more important mining districts in Sierra County. Gold was discovered in this district in 1877. The overall value of production prior to 1904 is estimated at $6,750,000. The Bonanza and Rattlesnake (Snake) mines were the most important producers. Since 1904 operations have been intermittent and as a rule on a small scale.

In 1933 many small shipments of gold ore were made to the El Paso smelter. In 1934 silver, gold, and copper ore valued at $60,109 was produced from 27 small lode deposits and 12 placer deposits. In 1935 the Hallett Construction Co. began large-scale operations on the placer ground in Gold Run, 6 miles east of Hillsboro. These operations continued until the Gold Order of November 5, 1942. This company handled about 100,000 cubic yards of gold-bearing sand and gravel per year. The William Little Co. handled about 70,000 cubic yards of gravel in 1935, and the Hoot Owl Co. about 40,000 cubic yards.

Lode mines that operated at intervals during the period 1935-1938 were the Biglow-Empire-Bonanza, the Portland-Sherman-Caballero, and the Snake-Opportunity groups, as well as the Wicks, Litel-King, M.K.T., and Ready Pay. A small amount of ore from the Conner Boy-Bank and Sherman was treated in a mill at Hillsboro in 1937.

In 1940 Dunzer and Everheart shipped ore from the Wicks mine. In the following year the Black Dome Mining Co. built a 60-ton gravity-flotation-amalgam mill on Percha Creek, one mile east of Hillsboro, and in 5 months treated 4,300 tons of ore and old tailings. The ore for this mill came from the Snake, Litel King, Golden Era, and Biglow properties. The Black Peak Mining Co. operated the Wicks mine in 1941 and shipped ore to El Paso. Other producers were the Duke, Tressness, and Tremont.

There was little activity in the district from 1942 until 1949. A small amount of gold-silver ore was shipped from the Snake and Bonanza mines in 1948. The Anderson Extension, Biglow, El Oro, Snake, Black Peak, and Portland properties were worked for short periods in 1950 and 1951. In 1952 the district produced 125 ounces of gold.

The rocks of the Hillsboro district consist of lower Paleozoic sediments cut by monzonite porphyry and capped by Tertiary andesite or latite flows. Three kinds of deposits occur in the district: (1) oxidized ores in the Mimbres limestone containing lead, manganese, iron, vanadium, and molybdenum; (2) ores containing gold, silver, and copper in veins or shear zones in the andesite; and (3) placers.

The oxidized ores, in which lead and vanadium are the important minerals, contain cerussite, wulfenite, and vanadinite and form lenses distributed along the contact between the limestone and the overlying Percha shales. They occur at a number of places over an area of several square miles but apparently do not extend far from the surface. A considerable amount of manganese is associated with the ore, and deposits consisting primarily of manganese minerals occur locally. Some siliceous limonite ore has been mined for fluxing purposes.

The gold-silver ores constitute the principal deposits of the district. They occur in quartz veins and consist chiefly of copper sulfides carrying gold and silver, but the quartz also carries a little free gold. Most of the veins are narrow but of high grade. They appear to converge toward an intrusive mass of monzonite porphyry at Copper Flat near Animas Peak.

The more important placers occur in the area just east of the Wicks mine and north of Percha Creek. The gold concentrations are found in the old channels of the draws or arroyos that come down from the Animas Hills. The overburden is thick, and water for operations is scarce.

HOT SPRINGS (MUD SPRINGS) DISTRICT

The Hot Springs district is west-northwest of the town of Truth or Consequences. Large low-grade manganese deposits occur on the west-

ern edge of the town. Soft sandstone beds of Santa Fe and later age locally contain considerable psilomelane and wad. The psilomelane is the more abundant and occurs as cementing material and as a replacement of individual grains of sand, changing the normally loosely consolidated sandstone to a hard, compact, very abrasive rock.

Several thousand tons of this ore was delivered to the U. S. Government's manganese stockpile at Deming during World War II. The Tower Mining Co. erected a concentrating plant near the deposit in 1951 and successfully treated the ores. The concentrates were sent to the Deming stockpile. The deposit was depleted by late 1954, and the mill was moved to Socorro County.

Copper- and silver-bearing ores occurring in veins along the southwest face of the Mud Springs Mountains, in the western part of the district, have been prospected and produced to a minor extent. Pods of chalcopyrite, bornite, and oxidized copper minerals have been found in the basal part of the Bliss (Cambrian) quartzite along several transverse fissure veins. The veins are richer in silver in the upper part of the quartzite and in the overlying El Paso limestone, and these portions are credited with a production of horn silver valued at about $40,000. The known deposits have been worked out, and no production has come from this area for many years.

KINGSTON (BLACK RANGE) DISTRICT

Kingston is on the east slope of the Black Range, 8 miles west of Hillsboro and near the head of Percha Creek. The Kingston mining district is extensive. It covers the area north, west, and south of the town and includes several old subdistricts. Silver was discovered here in 1880, and large production came from the district during the eighties and early nineties. The principal mines were the Lady Franklin, Kangaroo, Caledonia, Comstock, United States, Illinois, Calamity Jane, and Brush Heap. The production up to 1904 was valued at about $6,250,000, nearly all in silver, making this district one of the largest producers of silver in New Mexico up to that time. Owing to the depletion of the richer deposits and the decline in the price of silver in the early years of the present century, the camps of the district became largely inactive, as were the other silver camps of the country. Production declined to a mere carload or two of ore per year.

During the years in which silver was the most sought-for metal, little attention was paid to the occurrences of base-metal ores. The base metals have been sought in recent years and have accounted for most of the production from the district since 1915. Especially is this true of the period 1930-1949. Small shipments of silver-lead ore were made to the El Paso smelter in 1934-1936, the ore having come from the Keystone, Miner's Dream, Smiling Jane, and several unnamed prospects. In 1937 the Iron King began shipping lead ore to the Hanover mill. During the following year J. H. Moffit operators shipped seven cars of lead-silver ore to the El Paso smelter. The Virginian, Iron King, Southern Cross,

Independence, and Morris made intermittent shipments during 1939-1941. The Percha mine began shipping ore in 1942 and was the principal producer during the next 3 years. Small shipments were made from various properties in the district each year thereafter until 1952. The last reported production (other than manganese) was in 1952. In that year 3 ounces of gold, 1,666 ounces of silver, 1,400 pounds of copper, 21,000 pounds of lead, and 48,000 pounds of zinc were recovered from ores shipped from this district.

The ore deposits of the Kingston district are similar to those of the other districts in the Black Range. In addition to silver they contain lead, copper, and manganese. The ores are distributed along fractures in the limestone and occur in pockets and pipes along low, gently pitching arches in Ordovician limestone, below a silicified zone adjacent to the overlying Percha shale. The principal ores consist of lead, copper, and manganese minerals containing silver and gold in a clay gangue. Sphalerite is generally present and the manganese sulfide alabandite is found occasionally. Argentite, native silver, and cerargyrite occur. Rhodochrosite and rhodonite are among the primary gangue minerals. Oxidation of the manganese minerals has formed impure bodies of manganese oxides, and it is estimated that many thousands of tons of low-grade manganese ore exist in the district. Some of this ore was mined during World War II, and there is some production at the present time. All the manganese ore goes to the Deming stockpile.

LAKE VALLEY DISTRICT

Lake Valley is located 17 miles south of Hillsboro and 13 miles north of Nutt, a small station on the Rincon-Deming branch of the Atchison, Topeka & Santa Fe Railway. The district is famous for its production of silver during the 1880's and early 1890's. Silver ore was discovered here in 1878, and the famous "Bridal Chamber," one of the richest single bodies of silver ore ever discovered, was found in the early eighties. The mines were closed in 1893. During this short period of intensive activity over 5 million ounces of silver were recovered, about half of this coming from the "Bridal Chamber." Small shipments of iron-manganese-silver ore have been made to the El Paso smelter from time to time since 1900. The ore is used as a flux in the lead smelter. During the early days of mining, most of the ore came from the Sierra Grande, Sierra Bella, and Sierra Apache mines.

Large bodies of manganese oxide ores occur in the mines. Most of the ore is of such grade as to require concentrating before being marketable. During World War I some ore was shipped to the steel mills, and during World War II approximately 30,000 tons of ore was sent to the stockpile at Deming. During the war period large reserves of manganese ore were proven by the U. S. Bureau of Mines, and studies were made of methods for concentrating the ore. (See Apell et al., 1947; Dean et al., 1948.) In 1953 Haile Mines, Inc. erected a sink-float concen-

trating plant at Lake Valley, which presently is treating such ore successfully.

The ores of the district occur in the Lake Valley (Mississippian) limestone, usually in the lower beds, but in some places along the contact with the overlying shale; they commonly follow the bedding of the rocks. They occur near the surface in a zone several hundred feet wide and are close to a prominent intrusion of porphyry. The ore bodies are irregular in size and shape and are almost completely oxidized. Cerargyrite is the chief mineral of the silver ore, but other silver minerals are present. Some of the ore contains highly argentiferous cerussite and galena, but sulfides other than galena are rare. Iron and manganese are abundant as gangue minerals, coloring the silver ores brown or black. The manganese ore consists largely of manganite, pyrolusite, psilomelane, and wad. The silver content of the ore runs as high as 500 ounces per ton, and the manganese ranges from 12 to 40 percent. Zinc, copper, and gold occur in very small amounts.

LAS ANIMAS (GOLD DUST) PLACER DISTRICT

The Las Animas Placer district in recent years has been considered a part of the Hillsboro district. All production since 1930 has been reported as coming from the latter. The production by the Hallett Construction Co., William Little, and the Hoot Owl Co. between 1937 and 1942 is described on page 123.

MACHO DISTRICT

The Macho district is about 5 miles southwest of Lake Valley. Approximately 1,700 tons of lead-silver-gold ore was shipped from this district in 1926-1928. No production has been reported from the district since that time.

The prevailing rock of the district is andesite, which is cut by a number of radiating dikes of latite. The ore occurs in narrow veins along the dikes. The important minerals are cerussite and galena. Sphalerite is present in small amounts.

PITTSBURG (SHANDON) PLACER DISTRICT

The Pittsburg Placer district lies east of the Rio Grande, near the southwestern tip of the Caballo Mountains. It is about 20 miles northwest of Rincon, the nearest rail station.

Gold is distributed in a granite detrital material and occurs in a limited area west of the granite escarpment of the Caballo Mountains. The gold is coarse and unworn. It becomes less abundant toward the escarpment.

It is estimated that the Pittsburg placers yielded about 2,500 ounces of gold prior to 1930. During the thirties several attempts at a major operation were made. In 1933-1935 the Consolidated Mines Co., operating with a dragline and "Ainlay bowls," recovered gold from the Shan-

don and other placers, 669 ounces being reported in 1935. Several smaller operators each recovered a few ounces during that period.

In 1936 most of the work in the district was being done by the Pittsburg Placer Mining Co. and W. T. Warnick. The Caballo Construction Co. worked the Pittsburg ground in 1937, and William Little worked the property in 1939. Limited amounts of gold were recovered by small operators and individuals each year until 1942. The gold was sold to merchants in Hatch.

SAN MATEO MOUNTAINS DISTRICT

The southern end of the San Mateo Mountains, which extend into Sierra County from Socorro County, is made up of basal flows of andesite, andesite breccia, and overlying rhyolite tuffs, breccias, and flows.

Some prospecting has been done in the region, principally in the Goldsboro district, where a few tons of silver-bearing galena was mined and shipped to El Paso. Most of the prospecting has been for gold, but no deposits of commercial importance have been found. On the southwest flank of the range, near the Red Rock ranger station, copper prospects have been partly developed in andesite in what seems to be an extension of the Negro Diggings area in Socorro County.

Some prospecting has been done at Quartz Mountain, a small mountain of silicified rhyolite south of the main range. Quartz veins containing $4-$6 in gold per ton are reported. A small amount of work has been done at this place, but no shipments of ore have been reported.

TAYLOR CREEK TIN DISTRICT

This district is described under Catron County.

TIERRA BLANCA (BROMIDE) DISTRICT

The Tierra Blanca district is just south of Kingston and about 15 miles northwest of Lake Valley. Both silver and gold ores occur in the district. The history of this camp is similar to that of other camps of the Black Range. Mining was carried on vigorously during a brief initial period of discovery and development. Production soon declined, however, and the district has been idle for many years. In 1939, 1940, and 1942 L. E. Cleveland made small shipments of silver ore from his Silver Bell claims.

The silver ores occur in pockets and pipes in the Lake Valley limestone, just beneath or only a short distance below a bed of shale. The silver occurs in native form and in copper and lead sulfides. It also occurs subordinately as argentite, silver chloride, and silver bromide. Gold is found in the upper silicified part of the Mimbres limestone. Small pockets of hessite intergrown with native gold have been mined in the Lookout mine. Gold is said to occur in quartz gangue in a pipe-like body in Precambrian (?) granite in this district.

SOCORRO COUNTY

Socorro County lies in the southwest central part of the state. It has an area of 6,647 square miles, and the population is 9,665. Socorro, the largest town, is the county seat. It is located on the Rio Grande in the central part of the county and is one of the principal stations on the Atchison, Topeka & Santa Fe Railway between Albuquerque and El Paso.

The county is in an area of desert basins, out of which a number of mountain peaks and ranges rise abruptly. The Rio Grande Valley roughly bisects the county from north to south, separating it into two distinct parts geologically as well as physically. East of the river the prealluvium rocks consist chiefly of Carboniferous and Cretaceous sedimentary formations and the usual underlying Precambrian complex. The nonalluvial area west of the river is floored mostly by volcanic rocks.

The west side of the Rio Grande valley is bounded by the Ladron, Lemitar, Socorro, and San Mateo Mountains, named from north to south. The Magdalena Range, the largest range in the area, is located in the west central part of the county, just behind the Socorros. On the east side of the river are the Joyita and the Carthage Hills, lying about 15 miles north and about 12 miles southeast of Socorro respectively.

Owing to production from the Magdalena district, Socorro County has been one of the principal producers of metals in New Mexico. Gold, silver, copper, lead, and zinc have been the chief minerals produced. A little bismuth has been marketed. Tin and vanadium also occur, but very sparingly.

The total production of the county from 1904 to 1930 was valued at $22,225,489, of which zinc accounted for over $17 million. Production since 1930 has amounted to $17,235,502, divided among the metals as indicated in the accompanying table. Although many of the 28 mining districts and subdistricts of the county are old, there is no record of the value of production prior to 1904. Socorro County included Catron County until 1922. Production from the Catron County area is credited to Socorro County up to that year.

The boundary between Sierra and Socorro Counties was changed in 1951. Four mining districts (Goodfortune Creek, Grandview Canyon, Salinas Peak, Sulphur Canyon) formerly located in Socorro County are now included within the borders of Sierra County. As noted in Tables 17-18, production statistics for the two counties subsequent to 1950 are not affected by this transfer of territory.

The ore deposits of Socorro County have been described in detail by S. G. Lasky (1932).

CAT MOUNTAIN DISTRICT

Cat Mountain, about 13 miles southwest of Magdalena, is an island of Tertiary lavas within the alluvium. In this district low-grade gold-quartz in short, inconspicuous exposures crops out in andesite and rhyolite. Production from the district has been small, and there has been little activity or interest in the area since 1903.

CHUPADERA DISTRICT

The Chupadera district is about 6 miles northeast of Socorro, on the east side of the Rio Grande. The minerals showing are mostly copper carbonates, which occur in a thin-bedded sandstone layer in the Magdalena formation. In the same general area galena, barite, and fluorite occur sparsely in a calcareous sandstone member of the Chupadera formation.

The amount of work done in the district has been insignificant. No production has been reported.

COUNCIL ROCK DISTRICT

The Council Rock district is about 10 miles northwest of Magdalena, at the edge of the Tertiary lavas bordering the San Agustin Plains.

TABLE 18. PRODUCTION OF METALS IN SOCORRO COUNTY, 1904-1954*

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total Value
1904-1930	$133,343	784,177	8,912,835	44,419,683	224,623,111	$22,225,989
1931-1932†	-	-	-	-	-	-
1933	143	120	-	925,000	2,012,000	118,914
1934	5,627	1,949	7,600	458,300	1,132,000	73,128
1935	19,281	5,938	1,000	277,200	701,000	65,564
1936	63,434	5,791	1,000	211,500	566,000	106,040
1937	61,530	7,219	12,300	287,300	1,510,000	183,703
1938	3,808	268	700	14,200	435,000	25,583
1939	5,145	1,905	9,000	200,000	633,000	49,690
1940	700	962	2,600	129,000	411,000	34,021
1941	6,930	8,235	7,500	904,000	5,159,000	452,124
1942	2,695	29,998	22,800	1,728,000	6,370,000	734,972
1943	4,935	64,852	218,000	2,641,000	10,579,000	1,419,999
1944	4,480	66,081	245,000	3,240,000	8,948,000	1,363,818
1945	3,255	36,838	104,000	2,486,000	6,088,000	957,407
1946	4,375	69,614	272,000	2,547,000	6,948,000	1,229,966
1947	4,550	110,096	339,900	4,020,000	10,025,200	1,967,493
1948	5,390	97,061	254,000	5,904,000	9,726,000	2,498,727
1949	1,785	34,251	130,000	2,584,000	4,526,000	1,027,890
1950	4,375	32,261	342,000	2,754,000	3,358,000	956,955
1951‡	9,100	52,196	100,000	3,512,000	4,552,000	1,540,780
1952‡	7,700	61,495	114,000	3,794,000	4,244,000	1,406,282
1953‡	3,430	18,357	110,000	2,654,000	1,038,000	518,658
1954‡	105	470	28,000	3,528,000	16,000	503,888
Totals	$356,116	1,494,134	11,234,235	89,218,183	313,600,311	$39,461,591

* Production from Catron County included until 1922.

† Figures not available.

‡ Figures unaffected by the cession of territory to Sierra County in 1951.

The earliest discovered ore, which is said to have consisted of argentiferous lead carbonates, occurred locally along silicified fault zones. These veins were worked in the early eighties; there is no record of the value of the ore produced.

Within recent years renewed interest has been shown in the district, a little prospecting having been done on a low-grade copper showing and lead-zinc showings a short distance south of the old workings in the district. The copper occurs as a cementing material in a highly brecciated rhyolite or porphyry. The lead-zinc showings have been found in shear zones in the limestone just north of the rhyolite exposure. No production has come from these prospects, and the amount of work done has been slight.

HANSONBURG (CARTHAGE) DISTRICT

The Hansonburg district is at the east edge of the Jornada del Muerto, about 30 air miles east and slightly south from San Antonio, a station on the Albuquerque-El Paso branch of the Atchison, Topeka & Santa Fe Railway. The copper ores of the district first attracted attention in 1872. The lead ores were discovered later. With the exception of the last 6 years, operations in the district have been intermittent since its discovery. A dry concentrating mill built in 1916 to treat the lead ores at the McCarthy mine was not entirely successful. About 15 cars of copper ore and several cars of lead concentrates were shipped from the district prior to 1930.

Production from 1930 until 1948 continued sporadic. In 1937 one car of copper-silver ore was shipped. In 1938 the Louise-Halstead group was worked 36 days, and some high-grade lead-silver-gold ores were shipped to El Paso. In 1939 the Globe Mining Co. shipped 9 tons of lead-silver ore. No further activity was reported from the district until 1948.

The Portales Mining Co. was organized in 1947, acquired large holdings in the district, and built a gravity-type concentrating plant for the recovery of lead. The plant was constructed in the Rio Grande Valley alongside Highway 380, 1 mile east of San Antonio. The scarcity of water in or near the mine made it necessary to locate the mill in the river valley. The ore haul amounted to about 38 miles. The company began production in 1948. About 5,700 tons of ore was milled that year, with the recovery of 239,151 pounds of lead. The ore was galena associated with barite and fluorspar. No attempt was made to recover the latter minerals. The concentrates were sold chiefly to the Ozark Smelting 8c Mining Co., of Coffeyville, Kansas. Almost continuous production was maintained until the mill was destroyed by fire late in 1954. This mine is now inactive.

In 1948 the Royal Flush mine shipped 354 tons of ore, and the Mex-Tex Co. made some shipments from the Mountain Canyon group of claims. The Mex-Tex Mining Co., Inc., organized in 1949, acquired 8 claims in the Royal Flush group and 50 claims from the old Mex-Tex

Co. This company had just completed a barite grinding plant 1 mile south of San Antonio and immediately began the construction of a concentrating mill designed to recover both barite and lead from the ores of its newly acquired properties. The company did a large amount of development work during the winter of 1949-1950 and began production in the spring of 1950.

The new mill was designed to treat 500 tons of ore per day, recovering the barite and lead by jig and table separation. No attempt was made to recover the fluorspar that makes up about 15 percent of the ore. The lead concentrates are sold to various smelters, and the barite is ground and sold to the drilling-mud industry.

A third operator came into the district in 1950, when the Hurlow Mining Co. acquired the Major Jones group of claims and erected a jigging plant at the mine. Water for the operation of the plant was transported by truck. The operation was short lived.

The Portales Mining Co. processed 14,377 tons of ore in 1950, and the Mex-Tex probably half that much. The Hurlow Co.'s production was insignificant. This district was the chief producer of lead in New Mexico in 1954.

The ore deposits of the Hansonburg district occur as cavity fillings in localized areas along members of the fault zone that controls the western face of the northern Oscura Mountains. They are chiefly in the Magdalena limestone. The deposits show normal primary zoning of copper and lead, with widely varying amounts of barite and fluorspar. The mineralization along the cavity zone is discontinuous, and the ore bodies are pockety.

The lead ore is essentially argentiferous galena in a fluorite-barite gangue in a highly silicified limestone. A small amount of chalcopyrite is sometimes present, as are several oxidation products of the lead and copper sulfides.

Tennantite is the chief mineral of the deposits in which copper predominates. It occurs in a dolomite gangue and is of minor importance. Lead is entirely absent in these deposits. The ore is stained with copper arsenates and carbonates. No copper ores have been produced in recent years.

HOP CANYON DISTRICT

The Hop Canyon district is on the west side of the Magdalena Mountains, about 3 miles south of Kelly. A small amount of prospecting has been done along the shear zones in the volcanic rocks that show slight mineralization. No ore bodies have been found.

IRON MOUNTAIN DISTRICT

The Iron Mountain district is in the eastern foothills at the north end of the Cuchillo Mountains, about 12 miles north of Winston. The district was prospected for many years, but no ore bodies of commercial

importance were discovered. The principal minerals are the iron ores magnetite, hematite, and limonite. Several other minerals were noted early in the history of the district, among the most prevalent being helvite, an ore of beryllium, and scheelite, an ore of tungsten. These minerals are distributed sparsely throughout a large area. They were long considered of no importance, but during World War II, when both were of great strategic importance and in scarce supply, the U. S. Bureau of Mines and the U. S. Geological Survey undertook a major investigation of the Iron Mountain district (Jahns, 1944).

Haile Mines, Inc. did extensive development work on the more promising scheelite zones in 1951 and 1952. Several hundred tons of fair-grade tungsten ore was recovered, but no shipments were made.

The limestone of the district has been intruded by an elongated body of porphyry and has been strongly metamorphosed adjacent to the intrusion. The iron ores occur in the limestone near the contact with the porphyry. As exposed at the surface, the main ore bodies are roughly lens-shaped, ranging from 60 to 250 feet in width and averaging about 1,200 feet in length. They are overlain by beds of nearly pure garnet, and a little garnet occurs in the ore. The average grade of the ore bodies that have been sampled is about 45 percent iron.

JONES CAMP DISTRICT

The Jones Camp iron deposits are near the northern Oscura Mountains, about 47 miles east of San Antonio and 20 miles from Carrizozo, in Lincoln County, the nearest railroad station.

Discovered about 1900, the deposits were named after Fayette A. Jones, then president of the New Mexico School of Mines and prominent in the mining industry of the territory. The deposits were prospected by pits and trenches and proved fairly extensive. There was little or no production, however, until 1942 and 1943, when approximately 5,500 tons of ore was shipped to the steel mills at Pueblo, Colorado.

During the early years of World War II the deposits were examined and described in detail by the U. S. Geological Survey (Kelley, 1949).

Magnetite is the dominant ore mineral. The deposits are fairly large and of good grade, but carry small seams of gypsum.

JOYITA HILLS (CANYONCITO) DISTRICT

The Joyita Hills consist of a Precambrian granite core between Carboniferous strata and Tertiary volcanic flows. These hills form a short longitudinal range about 5 miles long on the east side of the Rio Grande, about 18 miles northeast of Socorro and 5 miles east of San Acacia, a station on the Atchison, Topeka & Santa Fe Railway. The hills are totally within the La Joya Grant, a large Spanish land grant currently owned by Gen. Thomas C. Campbell, of Albuquerque. The mineral deposits of the district have not been developed beyond the prospect stage, although some promising occurrences have been found.

The ore deposits occur as fillings in fissure veins in the Precambrian rocks and as open-space fillings and replacement bodies in the Magdalena limestone. They show a distinct relationship to the granite core. Galena, containing a little silver, is the chief ore mineral. A small amount of copper is found locally. Gangue minerals of the vein deposits are fluorite, barite, and quartz.

LADRON MOUNTAINS DISTRICT

The Ladron Mountains are about 25 miles northwest of Socorro. They consist essentially of a large mass of Precambrian granite bordered on the west slope by sedimentary rocks and nearly surrounded by Tertiary sands and conglomerate and Quaternary alluvium. Several small copper mineral exposures have been found, and appreciable manganese deposits occur in the limestone along the southwest flank of the mountain. At one of the copper showings chalcocite and oxidized copper minerals occur in a quartz fluorite gangue as open-space fillings in a brecciated granite adjacent to an andesite dike. In another exposure the copper minerals occur disseminated in loosely cemented Tertiary arkose and in an adjacent basaltic dike which separates the arkose from the Precambrian granite. Copper carbonates and silicate are found as cementing material in the arkose. No production of these ores has been reported.

The manganese deposits had been ignored until this material became critical during World War II. Several carloads of sorted ore were shipped in 1943. The deposits currently are receiving attention as a possible source of ore for the Deming stockpile.

LEMITAR MOUNTAINS DISTRICT

The Lemitar district is about 9 miles northwest of Socorro and about 3½ miles west of Polvadera.

Lead ore occurs as fissure filling in small scattered zones along the contact of granite with schists and with basic dikes in the Precambrian area at the east base of the mountains. The ore contains galena and in a few places small amounts of chalcopyrite and sphalerite. The gangue minerals are quartz, barite, and fluorite. The only recorded production from the district came from a small pocket of oxidized zinc ore.

LUIS LOPEZ MANGANESE DISTRICT

The Luis Lopez district is 5 miles west of the village of Luis Lopez, which is about 6 miles south of Socorro.

The principal ore-bearing rocks are strongly faulted, highly brecciated rhyolite or latite flows, in which the ore occurs as the cementing material along the fissures and cracks. Considerable calcite is associated with the manganese oxide ores pyrolusite and psilomelane.

Little attention was given to this district until the need for manganese became critical during World War II. The U. S. Bureau of Mines

inaugurated a core-drilling program in 1942. Based on the findings of this work, a development and production project was financed by the U. S. Government and a small amount of private capital.

The property came into production in 1944, about 125,000 tons of ore being processed by the end of 1945. Intermittent production continued until 1948. Since that time three different companies have attempted to operate the property. Apparently the ventures were unprofitable until recently, when selective mining procedure was followed. In 1954 a new mill using the sink-float method of concentration was erected and is proving very successful. The average grade of the ore is reported to be about 6.5 percent manganese, with zones that are much richer. The property is developed as an open-pit mine. Proven ore resources are large.

Within the past 2 years several new deposits have been discovered in the district. Some of these appear promising.

MAGDALENA DISTRICT

A detailed study of the geology and ore deposits of the Magdalena district has been made by the U. S. Geological Survey and the State Bureau of Mines and Mineral Resources under a cooperative agreement (Loughrin and Koshmann, 1942).

The Magdalena district is near the north end of the Magdalena Mountains, lying mostly on the west slope. The mining camp of Kelly was adjacent to the most productive area and was the largest camp in the district. The town of Magdalena is about 3 miles from the principal mines and about 2 miles from the ore-concentrating plant. It is at the end of the branch line of the Atchison, Topeka & Santa Fe Railway which leaves the main line at Socorro. A spur runs from Magdalena to the mill.

Ore was first discovered in the area in 1866 by Col. J. S. Hutchinson. The first ores mined were oxidized lead. These were smelted locally in an adobe furnace, and the metal was hauled to Kansas City by ox teams. In 1881 a smelter was built at Socorro, which treated ores from the Kelly and other mines in the area. After this smelter closed in 1893, the Graphic Smelter was built at Magdalena in 1896, treating the ores from the district until 1902. From 1894 to 1902 the Kelly and Graphic mines, the chief properties of the district, were worked with fair regularity.

Zinc carbonate ores were discovered in 1903. This discovery resulted in a marked increase in mining activity. The Graphic mine was purchased by the Ozark Smelting & Mining Co., a subsidiary of the Sherwin Williams Paint Co., and the Kelly and Nitt mines were acquired by the Tri-Bullion Mining & Development Co. Zinc carbonate ores constituted most of the production of the district from 1903 to 1906. From 1907 to 1920 the chief production came from zinc-lead sulfide ores, which were milled in the district or shipped direct to smelters outside the State.

During this period the Nitt mine produced a moderate amount of sulfide ore. The Kelly mine was purchased by the Empire Zinc Co. in 1913.

Mining operations were curtailed greatly in the district following World War I, but moderate production, mostly of carbonate ores, was maintained from 1922 to 1928. The Ozark Smelting & Mining Co. produced and milled a considerable tonnage of sulfide ores in 1926-1927. After being idle in 1931, the district had a limited production in 1932 and a substantial increase in 1933.

In 1934 ore was produced from the Kelly, Morning Star, and two other properties. The Kelly mine operated throughout 1935 and until December 15, 1936. All production from the Kelly mine went to the Ozark Co.'s plant, at Coffeyville, Kansas, whereas the ore from the other producers went to the American Smelting & Refining Co.'s smelter at El Paso. The Ozark Smelting & Mining Co. reopened its Waldo mine in April 1937; ore was produced until March 1938 and again from September 1939 to March 1940. The Kelly group produced intermittently during this period, and small lots of lead-silver ore were recovered from various dumps in the district. The Papa property shipped a few tons of silver-gold ore to El Paso, as did the Mistletoe and others.

In 1941 the Raskob Mining Interests, Inc., acquired a lease and option on the Waldo mine and mill. After repairing the mill and unwatering the mine, this company produced 20,211 tons of ore, which was treated at the mill. The Kelly mine shipped zinc-lead ore to the Hanover mill, in Grant County, and to the Ozark Co.'s plant, at Coffeyville, Kansas. The Victor Papa mine shipped 264 tons of lead, silver, gold, and copper ore to El Paso, and a few lots of ore were shipped from other properties.

The district produced 6,370,000 pounds of zinc and 1,728,000 pounds of lead in 1942, most of which came from the Raskob operations at the Waldo. The lease and option on this property were relinquished by the Raskob Interests on July 1, the property reverting back to the Sherwin Williams Co. This mine and mill were producing again in October 1942. The American Smelting & Refining Co. purchased the property in April 1943, and the mine and mill were operated continuously until June 1949. Production from the district was high throughout the period of World War II. Properties other than the Waldo that were active either continuously or intermittently were the Kelly and Lynchburg, belonging to the Empire Zinc Co., the Nitt, Blue Stone, Blue Hill, East Star, La Plata, Juanita, West Star, Papa, and others. Most of these were operated by lessees.

The Waldo was the only producing mine of importance in the district between the end of World War II and 1947. In 1947 many of the other properties were producing again. These included the Nitt, Lynchburg, Kelly, Juanita, Queen, Blue Stone, and Esperanza. Most of these mines were producing in 1948 and 1949. The Waldo mill treated custom ore in the latter part of 1949 and early in 1950. The mill was sold by

the American Smelting & Refining Co. in the spring of 1950 for dismantling.

The Lynchburg mine, belonging to the Empire Zinc Co. and under lease to Carl Alayer and associates, was the chief producer in the district in 1950. Some production also came from the Nitt, Juanita, Kelly, and Queen mines that year. Much of the ore went to the American Smelting & Refining Co.'s new mill at Deming.

The Magdalena district was the principal source of zinc in New Mexico for many years. Over 46 percent of the zinc output of the State from 1904 to 1928 came from this district. For the same period it accounted for 34 percent of the lead production. The overall value of production from this district since its discovery has been about $44,389,792 (see table).

In the Magdalena district the Magdalena Mountains consist of a core of Precambrian granite and argillite overlain by westward dipping sedimentary rocks of Mississippian, Pennsylvanian, and Permian age. The dip of the sedimentary rocks on the west side of the range is somewhat greater than the average surface slope. East of the crest Precambrian rocks predominate. To the south the sedimentary strata are overlain by flow rocks, which form the most prominent part of the range. Several large stocks and dikes of Tertiary monzonite and related rocks occur in the northern part of the district. Faults are numerous and are important structural features of the area.

The Lake Valley (Kelly) limestone of Mississippian age is the basal sedimentary formation of the district. It is crystalline crinoidal limestone about 125 feet thick, with a thin bed of quartzite at the base. Near the middle of the formation is the "Silver Pipe" stratum, a gray to black, sublithographic dolomitic limestone 5-10 feet thick. The Lake Valley limestone is overlain by rocks of the Magdalena group. The upper part of this group consists chiefly of massive limestone and smaller amounts of shale and quartzite, and is called the Madera limestone. The lower part consists of shale, quartzite, and subordinate limestone, and is known as the Sandia formation. The Permian Abo formation, consisting of sandstone and shale, overlies the Magdalena group in places.

The principal mineralization is confined to a zone in the sedimentary rocks which begins at the contact of a monzonite stock in the north central part of the district and extends southward nearly 4 miles. Almost all the known ore bodies are replacement deposits in the Lake Valley limestone. They commonly are adjacent to and above or below the "Silver Pipe" member. Several other ore horizons occur in the Lake Valley limestone and in the Magdalena group. A little mineralization occurs in monzonite, in extrusive igneous rocks, and in Precambrian rocks, but these deposits are unimportant.

Both primary and secondary ores occur in the district. Near the monzonite contact the primary ores are of the contact-metamorphic type. Adjacent to the contact they consist principally of specularite, magnetite, and subordinate sulfides; in places the sulfides, chiefly pyrite,

sphalerite, and chalcopyrite, are economically unimportant. Pyroxene, amphibole, and chlorite are prominent in the outer part of the contact-metamorphic zone, and garnet is present locally. The contact-metamorphic ores grade into typical lower temperature replacement bodies of sphalerite, galena, and minor chalcopyrite. Lead becomes more abundant, and zinc less abundant, as distance from the contact increases. Gangue minerals, which consist chiefly of quartz and calcite, occur in small amounts only. Barite is present locally in the sulfide zones but

TABLE 19. PRODUCTION OF METALS IN THE MAGDALENA DISTRICT, 1904-1954

Year	Gold (value)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total Value
Before 1904	-		-	-	-	$ 6,560,000*
1904-1930	$19,367	777,872	8,783,551	44,340,284	224,623,102	22,080,013
1931-1932†	-	-	-	-	-	-
1933	30	177	-	925,000	2,012,000	118,789
1934	220	62	50	453,600	1,132,000	65,723
1935	2,128	910	1,000	262,900	701,000	44,225
1936	1,195	319	1,000	211,500	566,000	39,563
1937	1,371	3,969	6,300	285,800	1,510,000	120,215
1938	2,782	163	150	11,200	435,000	24,297
1939	490	648	1,800	181,000	633,000	42,540
1940	525	459	2,600	129,000	411,000	33,844
1941	4,655	7,972	7,500	847,400	5,159,000	446,436
1942	2,595	29,998	22,800	1,728,000	6,370,000	734,972
1943	4,935	64,852	218,000	2,641,000	10,579,000	1,419,999
1944	4,440	66,081	245,000	3,240,000	8,948,000	1,363,818
1945	3,255	36,838	104,000	2,486,000	6,088,000	957,407
1946	3,990	69,607	271,800	2,546,000	6,948,000	1,229,499
1947	4,550	109,945	339,800	3,973,600	10,025,200	1,960,655
1948	5,265	96,776	254,000	5,651,000	9,712,000	2,451,285
1949	1,750	33,618	130,000	2,323,000	4,526,000	986,044
1950	4,270	34,924	340,500	1,851,200	3,354,000	832,882
1951	8,905	48,373	196,800	2,007,000	4,552,000	1,275,971
1952	7,525	57,695	110,800	2,284,000	4,244,000	1,144,282
1953	3,220	15,507	106,700	1,144,000	1,038,C00	253,849
1954	-	-	28,000	-	16,000	203,484
Totals	$87,463	1,456,765	11,172,151	79,522,484	313,582,302	$44,389,792

* Estimated.

† Figures not available.

is most abundant beyond the limits of intense mineralization. Fluorite is present here and there and is locally abundant in outlying parts of the district. Primary ore deposition probably occurred in Tertiary time. Secondary oxidized ores derived from the primary ores occur near the surface. During oxidation the lead and zinc were segregated into different bodies, the zinc carbonate ore forming a more or less regular shell partly enclosing lead carbonate ore of high purity. Smithsonite and cerussite were the most important oxidized minerals, but others

present included anglesite, cuprite, malachite, azurite, aurichalcite, goslarite, and chalcanthite.

MAGDALENA MOUNTAINS MANGANESE DISTRICT

The manganese-bearing area of the Magdalena Mountains is in the southeastern part of the range, from Water Canyon southward. The mouth of Water Canyon is about 16 miles west of Socorro and 4½ miles south of the Water Canyon station on the Magdalena branch of the Atchison, Topeka & Santa Fe Railway.

This part of the Magdalena Mountains is composed almost entirely of Tertiary volcanic rocks, chiefly rhyolite and associated tuffs and breccias. Manganese veins are numerous, but most of them are unimportant. The ore is mainly in rhyolite and occurs in fissures and brecciated zones. The veins range in thickness from a fraction of an inch to 4 feet. At the Water Canyon mine, where the most important veins of the district were found, the best ore was at a depth of 20 to 60 feet below an inconspicuous outcrop. The ore consisted of manganese oxides associated with limonite and manganiferous calcite. During World War I the Water Canyon mine produced 864 tons of high-grade ore and was then apparently mined out. The only other known occurrence of importance in the district is in the Negro Head mine located at the mouth of Six Mile Canyon, about 3 miles southeast of Water Canyon mine. At the Negro Head mine the ore occurs as a cementing material in a rhyolite breccia. This mine produced a very small amount of ore before World War II. During the war the U. S. Bureau of Mines completed a rather extensive core-drilling and trenching program on the deposit, reporting about 50,000 tons of medium- to low-grade ore (Russell and Calhoun, 1947). The mine produced a few cars of ore during the war period.

MILL CANYON DISTRICT

The Mill Canyon district is 13 miles, by road, south of Magdalena. It is near the crest of the Magdalena range, on the west side. Copper and lead mineralization occur sparingly in the volcanic rocks, which consist chiefly of andesite. The principal ore body found occurred in shattered andesite porphyry and contained considerable cuprite. At depth this graded into a mixture of oxide and sulfide minerals of copper containing a notable proportion of covellite. The ores contained some gold.

Production from the district was never large, and none has been reported for many years.

NORTH MAGDALENA DISTRICT

The North Magdalena district is in the low range of mountains just northwest of the town of Magdalena. The district includes a number

of prospects and undeveloped mineral claims in the volcanic rocks of the area.

Nearly all the veins have long outcrops and are of the shear-zone, fault-contact type. The deposits consist of copper-silver and lead-vanadium ores. The copper-silver ores contain oxidized copper minerals, chalcocite, covellite, and a worthwhile amount of argentite. They occur in small pockety shoots and fill fissure and breccia openings. The lead-vanadium ores occur along fault fissures which locally follow basic dikes. Galena is the chief ore mineral, but vanadinite, descloizite, and copper minerals are locally present. In some veins the type of mineralization exposed seems to bear a decided relationship to the kind of wall rock or breccia in the vein. Some gold has been mined from similar veins in the district, but these contain only traces of the base metals. No production has come from this district in recent years.

OJO CALIENTE DISTRICT

The Ojo Caliente district is at the southwest edge of the San Mateo Mountains, about 2 miles from old Fort Ojo Caliente and about 16 miles north of the Chloride district. A small prospect, known as the Taylor prospect, shows most evidence of attempts at mining.

The ore is completely oxidized and occurs in a vein in an altered andesite. Cerussite is the chief ore mineral. Oxidized copper and zinc, together with manganese and iron oxides, accompany the cerussite. Copper minerals apparently increase in amount with depth. The ore contains about 13 ounces of silver and a small amount of gold per ton. No production has been reported from the district.

RAYO DISTRICT

Rayo is about 12 miles south of Scholle, a station on the Belen-Clovis cutoff of the Atchison, Topeka & Santa Fe Railway. The ores of the district consist of copper carbonate and chalcocite, which occur in gray, loosely cemented Abo sandstone. Carbonaceous matter does not seem to be present.

The workings consist mostly of trenches and open cuts. A small amount of ore taken out in the course of prospecting seems to have been the only production from the district.

ROSEDALE DISTRICT

The Rosedale district is on the east side of the San Mateo Mountains, about 25 miles southwest of Magdalena. Gold was discovered here in 1882, and mining operations were fairly continuous until 1916. Most of the ore mined during this period was treated by amalgamation and cyanidation in a 10-stamp mill.

In 1934 the Black Bear Mining Co. shipped 58 tons of ore to the El Paso smelter. Early in 1935 the property was sold to the Rosedale Mining Co. This company completed a mill and treated 2,972 tons of

ore that year. Production was increased to 16,200 tons the following year, and in 1937, 30,500 tons of ore was treated between March 15 and December 2, when the mine was closed down. The ore was treated by tables and cyanidation, the table concentrates being shipped to the El Paso smelter. The most recent production from the district came in 1941, when a small amount of gold (35 ounces) and silver (128 ounces) was recovered from the Rosedale mine.

The ore in the district occurs in well-marked brecciated and shear zones in rhyolite porphyry and contains free-milling gold. Much manganese oxide is present locally and is said to be associated with the higher grade ore. Silver is present in small quantities.

SAN ANDRES MOUNTAINS DISTRICT

The San Andres Mountains in eastern Socorro County begin at San Augustin Pass, northeast of Las Cruces, in Dona Ana County, and extend nearly due north to Mockingbird Gap, in Socorro County, a distance of almost 75 miles. Numerous mineral deposits are scattered throughout the length of the range, but few have been developed beyond the prospect stage. The range contains five subdistricts: Goodfortune Creek, Grandview Canyon (San Andres), Mockingbird Gap, Salinas Peak, and Sulphur Canyon. With the exception of Mockingbird Gap (Socorro County), these subdistricts lie detached from Socorro County in territory annexed to Sierra County in 1951. The continued listing of the four "panhandle" districts under Socorro County is more convenient, however, for statistical purposes. The five subdistricts are described individually in discussing the San Andres Mountains district.

The range is structurally a westward dipping monocline consisting of a succession of Paleozoic rocks overlying the Precambrian complex, which is exposed on the steep east face. The strata are cut by faults and intruded by masses of monzonitic rock. Practically all the deposits occur along the eastern side of the range. For the most part they are fissure veins along small faults. Deposits of copper, lead, zinc, bismuth, and tungsten occur.

The whole region lies within the White Sands-Alamogordo military reservation and is not accessible for further prospecting or development.

Goodfortune Creek Subdistrict

The Goodfortune Creek district is about 45 miles west of Tularosa, on the steep east slope of the San Andres Mountains. The veins follow transverse faults and fissures. The ores consist chiefly of silver-bearing secondary chalcocite and copper oxidation products and are most abundant at the contact between the Precambrian granite and the Cambrian quartzite.

There are no records of the early production from the district. In 1934 a carload of copper-silver ore was shipped to the El Paso smelter, and again in 1937 and 1938 small shipments were made.

Grandview Canyon Subdistrict

Grandview Canyon is on the east slope of the San Andres Range, about 40 miles west of Tularosa. The ore bodies lie within the Precambrian rocks, chiefly granite and schist, and contain bismuth, tungsten, and copper. The bismuth minerals are found in pockets of various sizes enclosed within quartz lenses in schist. The ore minerals are bismuthinite, native bismuth, and bismutite. A small body of scheelite was found with the bismuth ore at one place. Pyrite and chalcopyrite are present locally in small amounts. The copper ores occur in a sheared hornfelslike rock as pods and veinlets of chalcopyrite and calcite in isolated shoots and bunches.

No records of production from this subdistrict are available.

Mockingbird Gap Subdistrict

Mockingbird Gap is the pass between the Oscura and San Andres Mountains. Most of the mineral deposits of the district lie in the San Andres Mountains, south of the gap. Copper and lead-zinc ores are found in the fault fissures in the Precambrian and Paleozoic rocks. The copper ores occur near the granite-sedimentary contact and are similar to the ores of the Goodfortune Creek district, though in general much more oxidized. The lead-zinc ores consist of galena and sphalerite, partly oxidized, in a calcite-quartz-barite gangue. A moderate quantity of silver is present. Production from the district apparently was not great, although no records are available covering early operations. In 1934 and 1939 small shipments of lead ore were made to El Paso. In 1941 the Mockingbird Mining Co. produced 811 tons of ore, which was treated in a jig mill. Because of lack of water at or near the mine, the mill was located at Tokay, 28 miles from the mine. The district is not accessible at this time.

Salinas Peak Subdistrict

Salinas Peak is an intrusive porphyry mass in the northern part of the San Andres Mountains, about 30 miles west of Three Rivers. Copper-lead ore occurs along a fault contact between the porphyry and the Magdalena limestone. The vein is several feet wide and contains galena and chalcopyrite and their oxidation products, as well as some silver.

A small shipment of lead-silver ore was made from the Smith group of claims in 1937. In 1947, 130 tons of ore was recovered from the Black Hawk-Latham and Chenowith groups. The Night Hawk mine produced 331 tons of ore in 1948, and a small amount of ore was sent from the Harding mine to the Hanson mill at Hot Springs.

Sulphur Canyon Subdistrict

Sulphur Canyon is about 4 miles north of Grandview Canyon. The copper ore of the district occurs in the Precambrian schist and consists

of oxidized copper minerals in a schist of coarsely crystalline chlorite. The single ore body seems to have been worked out entirely. There is no record of the production from the district.

SAN JOSE (NOGAL, SAN MATEO) DISTRICT

The San Jose (Nogal, San Mateo) district is near the crest of the rugged southeastern part of the San Mateo Mountains, 20 miles south of the Rosedale district. The gold-bearing veins of the region have been known for many years but received little attention until 1930, when a little high-grade gold-silver ore was discovered on the outcrop of the Pankey vein. The entire production of the district prior to June 1932 came from the Pankey outcrop and consisted of 160 tons of ore, valued at $1,387.

In 1934 the Springtime Mining Co. and T. B. Everheart shipped some gold-silver ore to El Paso. In the following year the Springtime Mining Co. completed a 40-ton mill and treated 1,295 tons of ore from the Pankey mine. Other prospects shipped 35 tons of ore to El Paso. The Pankey mill was operated until late 1936, and a car of "cleanup" concentrates from the mill was shipped in 1937.

The Pankey mine was reopened late in 1938 and produced and milled 48 tons of ore in 1939. The mill was closed down and a final cleanup made in 1940. Other small producers of ore during this period were the Victorio mine and claims owned by Ellison Warren. The Warren property produced 52 tons of ore in 1950. Prospecting and development work have been done during the past 3 years at the Melva mine, but no ore shipments have been made.

SAN LORENZO (SAN ACACIA) DISTRICT

The San Lorenzo district is west of San Acacia, in the northern continuation of the Lemitar Mountains. Small outcrops of oxidized copper minerals occur in a wide brecciated fault zone in the volcanic rocks. Manganese ore occurs in the vicinity of the contact between the volcanic rocks and the later Tertiary sandstone. The manganese ore occurs as a replacement and cementing material in irregular bodies of andesite conglomerate and in fissures in the andesite.

SCHOLLE DISTRICT

The Scholle district is at the junction of Socorro, Valencia, and Torrance Counties and includes a part of all three. The ore deposits are in the Abo sandstone and are similar to the typical copper deposits in Red Beds. The copper occurs as carbonates in the shale beds; as sulfides, chiefly chalcocite, associated with plant remains and fossil wood in arkose; and as nodules and lenses of sulfides, which replace the cement and feldspar of the arkose. Silver is present in small amounts. In places the oxidized ores contain vanadium, probably as a copper vanadate. Some occurrences of low-grade uranium oxide have been noted.

The district produced a small amount of ore steadily from 1915 to 1919, but production since then has been very erratic. The approximate total production from the district, all of which is credited to Torrance County in official reports, amounted to 10,380 tons of ore, containing 1,006,068 pounds of copper, 7,872 ounces of silver, and about $200 worth of gold, having a total value of $224,143. A negligible amount of lead was reported in the shipments. Several small leaching plants have been built in the district at various times, but they were unsuccessful.

SOCORRO PEAK DISTRICT

Socorro Peak is approximately 4 miles west of Socorro. Silver ore was discovered in the district in 1867, and the period of greatest mining activity was from 1880 to 1895. A custom smelter was constructed at Socorro in 1881. It was dismantled about 20 years later. Some of the ore from the district was treated at a stamp mill in Socorro. The mines have been shut down since about 1900, except for sporadic, small-scale operations. The production from the district has been estimated at from $760,000, to $1 million.

Socorro Peak is composed mainly of volcanic rocks, chiefly rhyolite and trachyte and associated tuffs and breccias. A considerable thickness of Pennsylvanian strata is exposed on the eastern face of the mountain, and at one place in the sedimentary area there is a small exposure of Precambrian argillite. A long tunnel in the sedimentary area exposed a large mass of monzonite porphyry, which, however, does not appear at the surface. The eastern face of the mountain is much faulted and fractured.

The principal ore deposits are in narrow veins in the volcanic rocks. The ore consists of silver halides in a quartz-barite gangue. Only a trace of base-metal mineralization is present.

Weak, scattered mineralization occurs in the sedimentary area, chiefly along the major fault zones. It consists essentially of small amounts of galena in an abundant barite gangue. Manganese oxides occur in brecciated zones and fault fissures.

The Socorro Peak district is presently not accessible to the general public.

WATER CANYON DISTRICT

The Water Canyon district adjoins the Magdalena district to the southeast. It is on the east slope of the Magdalena Range. The rocks consist of the Lake Valley limestone (Mississippian), Magdalena formation (Pennsylvanian), basal Precambrian argillite, and overlying Tertiary volcanic rocks. The formations are greatly faulted.

The most important ores of the district are in limestone and contain lead, copper, and zinc, accompanied by minor amounts of gold and silver. They occur most commonly as replacement bodies at intersections

of fissures with certain favorable horizons in the Lake Valley limestone. The ore bodies generally are rather small.

Some manganese has been produced from the district. The Water Canyon mine produced a small tonnage of high-grade ore during and subsequent to World War I. During World War II the Negro Head mine, at the mouth of Six Mile Canyon, produced several cars of medium- to low-grade ore for the Deming stockpile and the Luis Lopez district mill. The U. S. Bureau of Mines did considerable core drilling and trenching at the Negro Head mine during the war and proved the existence of a substantial amount of low-grade ore.

Considerable work was done at the Open Cut mine, in the Silver Hill subdistrict, a southern extension of the Water Canyon district. The Balakohna, the Rose Quartz, and La Plata mines were worked between 1933 and 1947. The minerals sought were gold and silver. Very little production has been obtained from this subdistrict.

TAOS COUNTY

Taos County is in central northern New Mexico. It lies between Rio Arriba County on the west and Colfax County on the east, and its northern boundary is the Colorado state line. Its area is 2,256 square miles, and the population is 17,305. Taos is the county seat.

The Rio Grande traverses the central part of the county from north to south. The river is confined to a narrow gorge, over 1,000 feet deep, in its entire passage across the county. From the river westward the county is mainly a basalt plateau. No metallic minerals have been found in this area. Eastward from the river the county is occupied, first, by several miles of basalt plateau, then by foothills, and finally by the main range of the Sangre de Cristo Mountains. The crest of this range forms the boundary between Taos and Colfax Counties. It is also the divide between the Rio Grande and Mississippi River drainage basins. The mountains consist chiefly of Precambrian granites and schists and Pennsylvanian limestones.

The county contains five mining districts, all confined to the mountain areas and the gravel beds in the canyons and at the foot of the range. With the exception of the molybdenum deposits in the Questa area of the Red River district and the Harding mine, of the Picuris district, all known deposits are of secondary importance insofar as present workings and exploratory efforts indicate. The gold, silver, copper, and lead produced in Taos County prior to 1923 had a value of less than $100,000, and there has been very little production of these metals from the county since that time.

The production of molybdenum from the Red River district has been continuous since 1922, with the exception of very short periods. This district has accounted for most of the metal produced in the county.

The Harding mine has produced ores of beryllium and lithium since 1943.

The mineralized areas of Taos County were prospected primarily for gold in the early days, little or no attention being paid to the base metals. Consequently, the potential of these metals in the mining districts is still unknown. Some prospecting and a little development work have been done in recent years on some of the copper-bearing outcrops, but no ore bodies have, as yet, been uncovered. The amount of work done has been small when compared with the area involved and the mineralization that is known.

The Red River district, the largest and most promising in the county, is handicapped by its remoteness from rail transportation and its poor highways.

ANCHOR (LA BELLE) DISTRICT

The Anchor district is on the west slope of the Sangre de Cristo Mountains, about 8 miles north of the village of Red River. The deposits are oxidized auriferous pyrite-quartz veins in a highly decomposed monzonite and diorite porphyry. The veins are narrow and irregular. Most of the pyrite has been oxidized. The resulting hematite and limonite enclose, in a free state, the small amounts of gold originally contained in the pyrite. No record of the production from this district is available. The mines have been idle for many years.

PICURIS (COPPER HILL) DISTRICT

The Picuris district is in the extreme south central part of the county and is reached by way of State Highway 75. The rocks of the district are metamorphosed Precambrian sediments and pegmatite dikes.

The district was first worked in the late nineties and early 1900's, when very extensive exploratory work was done on veins of glassy quartz carrying copper and gold. Several hundred feet of tunnels and shafts are in excellent condition today. At one time a small mill was erected and some ore treated, but the venture proved unsuccessful, and the copper-gold properties have been abandoned since 1917.

Some of the pegmatite dikes in the district contain very appreciable amounts of several of the so-called "rare earth" minerals, which were long considered unimportant. The Harding mine in recent years has produced ores of tantalum, beryllium, and lithium in important amounts.

Wolframite has been mined near Penasco, a few miles south of Picuris (Hess, 1917, p 28). Wolframite, with cuprotungstite, occurs near Rinconada (see Rinconada district, Rio Arriba County).

The Harding mine is the only active property in the district at this time.

RED RIVER DISTRICT

The Red River district includes a considerable area around the town of Red River, on the western slope of the Sangre de Cristo Mountains. The town is 13 miles east of Questa, at the confluence of several tributaries of the Red River, a short stream that flows westward into the Rio Grande.

The rocks of the Red River district consist mainly of intrusive porphyries, volcanic tuffs and flows, and the Precambrian complex that forms the main Sangre de Cristo Range in this region.

Prospecting in this district is said to have started in 1869, shortly after the gold strikes in the Elizabethtown district of Colfax County, some 20 miles to the east. Gold was recovered from both lode and placer deposits. A smelter, built in 1879 at the site of Red River, was operated only a short time.

The mineral deposits in the district occur most commonly in the intrusive rocks, but in places occur in the later volcanic rocks. The veins are generally narrow and discontinuous, and are variable in width and direction. Pyrite is the most abundant of the sulfides, but galena and sphalerite are common. Chalcopyrite and molybdenite occur in small amounts, and petzite has been found in the Independence mine. The gangue minerals consist of quartz, calcite, and fluorite in various proportions. Many of the veins contain much silicified and pyritized breccia fragments of country rock.

The ores are valued chiefly for their gold content, but in one or two deposits lead is the chief metal. Production of gold from this district has not been great, and the recovery of base metal other than molybdenum has been negligible.

The important molybdenum deposits were recognized about 1917. The veins had been discovered many years earlier, but the molybdenum was mistaken for graphite, and the yellow molybdic ocher was thought to be sulfur. The Western Molybdenum Co., organized to develop the deposits, accomplished very little, relinquishing its holdings to the R. & S. Molybdenum Mines Co. in 1918. Production began on a small scale in 1919, the ore being treated at a remodeled gold mill nearby.

In 1920 the mines were taken over by the Molybdenum Corporation of America, which was organized for this purpose. Operations continued on a small scale until a new flotation mill was completed in 1923. Since then production has been continuous, except for brief shutdowns due to labor trouble or equipment breakdowns. The mine normally produces 40-60 tons of ore per day, the average grade of which has been 2-3 percent molybdenum sulfide (MoS_2). In recent years great improvements have been made in milling the ore; recovery has been so improved that much of the old tailings dump is being remilled. Total production from this deposit has been approximately 30 million pounds of molybdenum sulfide, most of which was converted into ferromolybdenum or calcium

molybdate at company plants in the East. Known ore reserves now are so limited that the mill and mine are expected to close down permanently in the near future, unless new ore is found during the extensive exploration now being carried on.

The veins that carry the molybdenum occur in eastward trending sheeted zones several hundred feet wide along the margin of soda granite stock. No commercial veins have been found in the intruded volcanic rocks, although small veins and stringers are common in this rock. The larger veins follow the stronger shear lines and are joined together by a network of branching and intersecting veinlets and stringers. The veins are faulted by numerous barren transverse fractures. Displacement is rarely great, but its direction and amount are so erratic that considerable difficulty is experienced in developing the ore veins.

The vein filling consists mostly of quartz, but may contain a large proportion of molybdenite. Some pyrite and a little chalcopyrite, fluorite, biotite, rhodochrosite, and calcite also may be present.

Molybdenite mineralization has been found in several places in the Red River district, other than in the area being mined, but exploratory work, so far, has not uncovered ore of commercial grade.

Other mining operations that produced ore in the early days of the district were the Black Copper, Memphis, Independence, Midnight, Caribel, Big Five, and Anchor, together with many lesser prospects. The principal values were in gold. Several of these properties have received attention in recent years. Work has been done on the more promising deposits, but no successful operation has resulted. The working of small placer deposits close to the town of Red River was attended with little success.

Many private geologic reports have been prepared covering properties in the district, but venture capital for carrying out recommendations has been scarce.

RIO GRANDE PLACER DISTRICT

Placer gold occurs here and there in the sand and gravel deposits of the Rio Grande valley in Taos County. These deposits occupy an area of many square miles and are several hundreds of feet thick in places. The most promising part probably begins near the mouth of the Red River, in the northern part of the county, and extends southward as far as Embudo, in Rio Arriba County, a distance of about 40 miles. The river flows in a moderately deep gorge for a considerable distance in the gravel area.

The placer deposits of the area consist of bench placers, river-bar placers, and deep river placers. The bench deposits are the most extensive, but the gold probably does not occur in them in commercial amounts. Large areas of the placers are capped by basalt, and basalt flows are interbedded with the gravels. The basalt forms the rims of the canyon through which the river flows. The river-bar deposits, although

much smaller than the bench deposits, have yielded practically all the meager amount of gold recovered. Several tests of the river gravels have been made, and gold in encouraging amounts was found in places. During the early thirties a company headed by former Vice President Charles Curtis attempted to recover gold from the river channel near the Taos Junction bridge. A floating dredge was constructed and operated for a few weeks. It was soon discovered, however, that the gravel beds did not respond to bucket dredging, owing to the large amount of basalt fragments present in the deposits. The operation was short lived.

The depth of the river gravels is not known, but it is probably very great in most places. Undoubtedly the basalt, or malpais, fragments are present throughout the deposits, making successful dredging operations impossible.

TWINING (ARROYO HONDO) DISTRICT

The Twining district is located about 15 miles northeast of Taos. The rocks of the district are Precambrian granite and schists cut by prominent monzonite porphyry dikes. The principal deposits are in amphibolite and chloritic schist and contain disseminated pyrite, chalcopyrite, and bornite. The ore is of very low grade. A number of small veins close to the porphyry dikes are said to contain galena, stibnite, gold, chalcopyrite, sphalerite, and molybdenite.

The principal mine in the district is known as the Frazier copper prospect (Lindgren et al., 1910, p 84). Considerable work was done on this property, but the operation was not profitable, and the mine was closed about 1904 or 1905. During 1942-1943 parts of the old workings were cleaned out, but very little new work was done. All the rather extensive tunnels and shafts are now caved.

There is no record of any production from this district.

TORRANCE COUNTY

Torrance County has an area of 3,340 square miles and a population of 8,057. It is located in the center of the State. The county seat is Estancia. The chief industries are farming and the raising of livestock, but there has been some metal production from the Manzano Mountains area, along the west edge of the county. This production has not been great, amounting in all to about $225,000. Some of the earliest mining dates back to Spanish colonial days.

The only mining district is located in the extreme western part of the county, near the village of Scholle, a small community on the Atchison, Topeka & Santa Fe Railway. All production of metallic ores (chiefly copper) has come from the Scholle district (listed under Socorro County). The ore minerals are chalcocite, malachite, and azurite, which occur in the Red Bed sandstones. The ore-bearing beds are fairly flat and vary in thickness from 1 to 12 feet. The mineralization is very

irregular; concentrations are scattered and seldom of sufficient richness to be classed as ore.

No production has come from this county for many years. At the present time, however, renewed interest is being shown in the Scholle district, because of the discovery of uranium ores in the area. These have not yet been developed.

UNION COUNTY

Union County is situated in the northeast corner of the State. It borders Texas and Oklahoma on the east and Colorado on the north. The county has an area of 3,817 square miles and a population of 7,275. Clayton, located on the Colorado and Southern Railroad, is the county seat.

There are no mining districts in this county, nor is there any record of the production of metals or metallic ores. In early colonial days, when the Santa Fe Trail was still the main travel route between New Mexico and the East, occasional reports of placer gold along the Dry Cimarron River were heard in Santa Fe. No authentic discoveries, however, were recorded.

VALENCIA COUNTY

Valencia County, in western New Mexico, extends from Torrance and Bernalillo Counties westward to the Arizona state line. It straddles the Rio Grande Valley in the east and laps far over the Continental Divide in the west, having an area of 5,637 square miles and a population of 22,574. Los Lunas, in the Rio Grande valley and on the El Paso branch of the Atchison, Topeka & Santa Fe Railway, is the county seat.

Most of the county is covered with Cretaceous strata, but there are large areas of Permian and Triassic Red Beds and Quaternary basalt.

Metalliferous ore deposits in the county were generally considered unimportant prior to the discovery of uranium ore in the Grants-Mount Taylor area. A small amount of copper was produced prior to 1930 from the Red Bed deposits southwest of Grants and from similar deposits east of the Rio Grande. In recent years sporadic efforts have been made to mine a siliceous copper ore suitable for the needs of the El Paso smelter, but it has been impossible to maintain the required grade of ore.

The uranium ore deposits, discovered in 1950, are being prospected and developed under Atomic Energy Commission supervision. The ore is uraninite and tyuyamunite, occurring in the Todilto limestone and the Morrison and other sandstones in the southern extension of the Colorado Plateau region.

Total metal production from the county, other than recently produced uranium, has had a value of less than $10,000.

TABLE 21. PRODUCTION OF METALS IN NEW MEXICO THROUGH 1954

Year	Gold[a]		Silver[a]		Copper		Lead		Zinc		Iron Ore		Manganese Ore[b]		Manganiferous Ore[c]		Molybdenum		Miscellaneous[d] Ore and Concentrates	Total
	Ounces	Value	Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	Long Tons	Value	Long Tons	Value	Long Tons	Value	Pounds	Value	Value	Value
Prior to 1880[e]	749,000	$15,483,000	10,000,000	$12,500,000	30,000,000	$ 6,000,000	25,000,000	$ 1,500,000	—	—	—	—	—	—	—	—	—	—	—	$ 35,483,000
1880-1903[f]	654,718	13,534,219	23,731,517	22,328,441	49,366,527	7,217,170	157,017,326	6,227,212	3,011,297	$ 142,760	410,000	$ 585,000	—	—	—	—	—	—	—	50,034,802
1904-1930[g]	821,431	16,980,481	25,280,391	16,817,286	1,345,157,885	234,420,138	171,063,833	10,413,773	615,018,152	43,867,607	4,443,463	7,334,751	22,650	$ 412,432	523,731	$1,881,081	3,000,000	$1,789,572	$ 125,000	334,042,121
1931-1954	419,690	13,528,681	18,781,733	12,584,535	2,382,356,100	413,616,359	304,605,000	24,466,392	1,581,849,000	155,828,799	430,800	1,145,353	68,792	2,056,479	1,032,114	3,415,293	12,555,000	6,690,745	4,121,426	687,454,062
Totals	2,644,839	$59,526,381	77,793,641	$64,230,262	3,806,880,512	$661,253,667	657,686,159	$42,607,377	2,199,478,449	$199,839,166	5,284,263	$9,065,104	91,442	$2,468,911	1,555,845	$5,296,374	15,555,000	$8,480,317	$4,246,426	$1,057,013,985
									PRODUCTION, 1931-1954											
1931	31,161	644,160	1,041,859	302,139	61,503,100	5,596,782	22,537,000	833,869	55,732,000	2,117,816	165,518	429,721	—	—	—	—	96,000	40,200	—	9,964,687
1932	23,208	479,753	1,142,351	322,143	28,419,000	1,790,397	20,227,000	606,810	51,186,000	1,535,580	—	—	—	—	—	—	500,000	220,000	—	4,954,683
1933	26,474	547,268	1,181,580	413,553	26,947,000	1,724,608	22,086,000	817,182	61,848,000	2,597,616	—	—	—	—	—	—	500,000	220,000	—	6,320,227
1934	27,807	954,380	1,061,775	686,400	23,630,000	1,890,400	18,729,000	692,973	53,043,000	2,280,849	—	—	—	—	—	—	—	220,000[e]	—	6,725,002
1935	33,435	1,170,225	1,061,902	763,242	4,505,000	373,915	14,578,000	583,120	44,252,000	1,947,088	—	—	—	—	—	—	—	220,000[e]	—	5,057,590
1936	33,037	1,156,295	1,163,255	900,941	6,332,000	582,544	13,252,000	609,592	41,336,000	2,066,800	17,621	48,634	—	—	—	—	—	220,000[e]	—	5,584,806
1937	41,171	1,440,985	1,243,766	962,053	64,106,000	7,756,826	13,024,000	768,416	47,854,000	3,110,510	9,440	28,320	878	23,047	20,005	59,750	631,000	252,400	1,200	14,403,507
1938	43,050	1,506,750	1,229,860	795,061	40,878,000	4,006,044	9,898,000	455,308	56,472,000	2,710,656	1,826	5,578	560	14,700	5,727	17,067	—	—	—	9,511,164
1939	36,979	1,294,265	1,400,878	950,899	92,284,000	9,597,536	10,784,000	506,848	58,712,000	3,053,024	—	—	339	8,898	36,854	114,247	—	—	—	15,525,717
1940	35,943	1,258,005	1,407,839	1,001,130	139,696,000	15,785,648	7,644,000	382,200	60,626,000	3,819,438	—	—	45	1,181	40,904	126,802	—	—	—	22,374,404
1941	27,845	974,575	1,328,317	944,581	146,956,000	17,340,808	9,336,000	532,152	75,724,000	5,679,300	—	—	—	—	70,344	235,652	—	—	—	25,707,068
1942	11,961	418,635	676,170	480,832	160,200,000	19,384,200	9,216,000	617,472	92,922,000	8,641,746	89,166	231,830	6,508	170,835	79,721	213,564	—	—	—	30,159,114
1943	5,563	194,705	463,583	329,659	152,326,000	19,802,380	11,446,000	858,450	119,048,000	12,857,184	41,744	134,800	187	13,832	104,966	327,890	—	—	4,440	34,523,340
1944	6,918	242,130	535,275	380,640	139,460,000	18,827,100	14,530,000	1,162,400	101,454,000	11,565,756	33,460	89,700	273	7,155	91,917	242,675	—	—	75,096	32,592,652
1945	5,604	196,140	465,127	330,757	113,142,000	15,274,170	15,324,000	1,317,864	80,590,000	9,267,850	369	1,100	3,334	179,235	85,744	186,662	—	—	31,446	26,785,224
1946	4,009	140,315	338,000	273,104	100,382,000	16,261,884	9,798,000	1,067,982	72,206,000	8,809,132	—	—	1,166	62,684	72,298	242,198	—	—	8,593	26,865,892
1947	3,146	110,110	515,833	466,829	120,410,000	25,286,100	12,766,000	1,838,304	88,206,000	10,672,926	—	—	858	46,126	74,000	270,000	1,404,000	493,111	36,855	39,220,361
1948	3,414	119,490	537,674	486,622	149,374,000	32,414,158	15,306,000	2,739,774	83,004,000	11,039,532	—	—	—	—	71,000	266,250	1,616,000	650,483	4,800	47,721,109
1949	3,249	113,715	380,855	344,693	110,776,000	21,822,872	9,304,000	1,470,032	58,692,000	7,277,808	—	—	—	—	55,000	220,000	1,002,000	448,568	63,993	31,761,681
1950	3,414	119,490	338,581	306,433	132,600,000	27,580,800	9,300,000	1,120,500	58,526,000	8,310,692	28,659	63,304	1,700	27,000	60,000	240,000	1,444,000	755,762	68,768	38,592,749
1951	3,959	138,565	443,267	401,179	147,116,000	35,602,072	11,692,000	2,022,716	90,838,000	16,532,516	32,210	63,304	1,700	27,000	60,500	240,000	1,444,000	755,762	47,008	55,830,122
1952	2,949	103,215	479,318	433,807	153,224,000	36,838,208	14,042,000	2,260,762	101,950,000	16,923,700	7,793	31,172	3,352	82,428	52,934	211,736	1,402,000	785,682	73,185	57,743,895
1953	2,600	91,000	205,000	185,535	140,600,000	40,211,600	5,600,000	744,800	27,600,000	3,008,400	2,644	15,440	9,189	278,790	42,000	168,000	1,118,000	621,212	561,048	45,885,825
1954	3,294	114,510	139,668	122,303	127,490,000	37,865,307	4,186,000	456,866	28,000	2,880	350	2,450	38,703	1,113,568	8,200	32,800	1,398,000	787,565	3,144,994	43,643,243
Totals (1931-1954)	419,690	$13,528,681	18,781,733	$12,584,535	2,382,356,100	$413,616,359	304,605,000	$24,466,392	1,581,849,000	$155,828,799	430,800	$1,145,353	68,792	$2,056,479	1,032,114	$3,415,293	12,555,000	$6,690,745	$4,121,426	$637,454,062

[a] Including placer production.
[e] Estimated.
[f] Largely from official sources, but some estimates included.
[g] Figures for gold, silver, copper, lead, and zinc from 1904 to 1930 are from the annual reports in Mineral Resources of the United States, by Charles W. Henderson. Figures for other metals were compiled from various sources, mostly from the Mineral Resources series.

[b] 35% or more of manganese.
[c] 5%-35% of manganese.

[d] Tungsten, beryllium, thorium, cerium, tantalum, vanadium, and uranium.
[e] Estimated.

Economic Features of the Metal Mining Industry in New Mexico

The mining of metallic ores always has been a major industry in New Mexico, but at no time has it been more vital to the economy of the State than at the present. Employment in the mines, mills, and smelters has increased steadily, and the value of the metals produced has reached all-time highs during the past few years. Wages have increased, and working conditions have improved greatly.

Table 21 provides an overall record of metal production, and the accompanying charts (figs 1-5) illustrate the production and value of the more important ores and metals between 1910 and 1954. A study of these charts reveals the influence of periods of national and world emergency, and of business booms and depressions, on the production and value of metals.

Between 1910 and 1941 production of the precious metals, gold and silver, was not as greatly affected by world conditions as was that of the base metals. In fact, during the depression years of the thirties, gold and silver production increased, while that of other metals reached new lows. This was due chiefly to the 1932 increase in the price of gold and to the fact that many unemployed persons in the Western states turned to gold mining as a means of livelihood. Since 1941 practically all the gold and silver produced in the State has been recovered as byproducts of base-metal mining. Today there are no gold-silver mines in operation in New Mexico.

The base-metal charts show the effects of the depression years following World War I and following the boom period of the late twenties. It is of special interest to note that in the years following 1929, there was a rapid decline in production until 1937, when general world unrest foreshadowed the approach of World War II. During this period the production of zinc and lead declined only moderately as compared with copper. This, it appears, can be attributed to the fact that the greatest production of these metals at that time came from mines of the American Metal Co., at Tererro, San Miguel County, where mining conditions were such that to curtail or discontinue production was not economically feasible. The enormous amount of water and the extremely heavy ground encountered made continuous operation necessary, if the mine was not to be abandoned and lost entirely. The most economical operational program was determined by trial during the early months of the depression period, and production was maintained on this schedule throughout the remaining life of the mine.

During World War H there was a tremendous expansion of the mining industry in the State. This has continued through the postwar years. The years 1951 and 1952 saw production totals and value figures

far beyond any known before. This, of course, means more rapid depletion of known ore reserves. It also means that many low-grade mineral deposits that have heretofore been considered economically unimportant will be reappraised, and that a more intensive search will be made for new ore bodies in active mining districts.

The discovery and proving up of extensive reserves of uranium-vanadium ores in the northwest quarter of the State have added substantially to the mineral wealth and the future economy of New Mexico.

Uranium

DISCOVERY AND DEVELOPMENT OF ORE BODIES

The minerals torbernite and autunite were the first uranium-bear. minerals recognized as occurring in New Mexico. They were found associated with the copper, lead, and zinc ores of the White Signal district, in Grant County, where they were confused originally with the green copper carbonate which is locally present. The true nature of the green mineral was first recognized by Mrs. A. A. Leach in 1918, and considerable effort was made to develop and exploit the deposits in order to recover the small amount of radium that was thought to be present. The project was not successful.

Oxides of uranium and vanadium were recognized in a small zone in the Bland mine, in the Cochiti (Bland) mining district of Sandoval County, about 1919 or 1920. The minerals are reported to occur as filling in fractures in a silicified volcanic breccia. No particular attention was given this occurrence at the time.

A third occurrence of uranium-vanadium minerals was reported from the Scholle mining district of Socorro-Torrance-Valencia Counties, in the early 1930's, by T. B. Everheart, who was mining sandstone copper ore in the area at that time. The minerals occur here with carbonaceous debris in thin shale seams between the beds of hard Abo sandstone.

Undoubtedly many other occurrences of the bright yellow uranium minerals were noted by early prospectors and mine operators, but they were probably thought to be sulfur or yellow iron ochre.

After the nature of the Manhattan Project was made public, and the critical need for domestic sources of uranium was realized, intensive prospecting was initiated in the Colorado Plateau region of southwestern Colorado and southeastern Utah, an area in which vanadium-uranium ores had been mined for many years, the vanadium being recovered and the uranium minerals discarded. With the inception of the Manhattan Project, the old dumps and tailings ponds of the district were reworked for the uranium. It was generally thought in the early years of prospecting that the Colorado-Utah area of the Plateau was the only region in the United States in which uranium minerals of the required richness and volume could be found. It was also thought that the mineral concentrations occurred only in sandstone rocks of the Jurassic geologic age. Both of these ideas were soon discredited by discoveries in other geologic horizons, in rocks other than sandstone, and in sections outside the then recognized Colorado Plateau area.

Following World War II the United States Atomic Energy Commission set up an attractive schedule of ore prices and incentive bonuses

for the discovery and production of uranium ores. Almost overnight uranium became a magic word, and prospectors swarmed to the Plateau country. The stampede surpassed anything witnessed before in a mining country; the gold rushes to California and Alaska were dwarfed by comparison.

New Mexico, as a promising hunting ground for uranium, was relatively ignored by prospectors during the first year or two of the rush. Even native prospectors were not much interested in looking for the ore locally, in spite of the fact that a large section of the so-called Colorado Plateau region was known to extend well into the northwest quarter of the state. After the first discovery was made in that area, it was learned that geologic mapping parties had stumbled over outcrops of the ore and either had not recognized the minerals or had considered them of no importance!

The first discovery of uranium ore in the State occurred in the spring of 1950, and was made by a Navajo Indian, Paddy Martinez. The discovery was made on land belonging to the Atchison, Topeka & Santa Fe Railway Co., on a small mesa or butte known as "Haystack Mountain," located a few miles north of the village of Prewett, in McKinley County. The mineral occurred in a limestone, later identified as the Todilto formation of Jurassic age. Until this discovery limestone was not considered a favorable host rock for uranium minerals.

The railroad company, upon being informed of the Haystack Mountain discovery, quietly launched an exploratory and evaluation program on its lands, and numerous other showings soon were located. A drilling and development program proved up substantial bodies of commercial-grade ore in the limestone, and discoveries were made also in sandstone members in the area. The Morrison and Dakota formations were found to carry concentrations of uranium minerals of ore grade.

News of this discovery spread rapidly, and the northwest quarter of New Mexico soon became the mecca for prospectors from all parts of the United States. Much of the area is owned by Indian tribes and by the State. The Atchison, Topeka & Santa Fe Railway Co. also owns considerable acreage in this area. These lands are subject to lease, but not to mineral location by discovery and claim. Some confusion developed early as to ownership status in the region, and a scramble began for leases on State and Indian lands. The railroad company early indicated that it intended to prospect its own lands and would develop and produce all ore bodies found.

The Atomic Energy Commission investigated the discoveries in the Grants-Prewett area and concluded that the district had promising possibilities. It established a branch office at Grants in the fall of 1950 and set up a depot for buying ore near Bluewater, about 8 miles west of Grants. An agreement was negotiated with the Anaconda Copper Mining Co. for the construction of a mill near Bluewater to treat the ores

and to recover both the uranium and vanadium minerals. This mill, it was realized, necessarily would be different from other concentrators operating in the Plateau region, because of the type of ore to be treated. Limestone ores made up practically all known reserves in the area at the time the agreement was made.

Entering the district in 1951, the Anaconda company immediately began a broad, intensive program of prospecting on lands leased from the State, the Indians, and private ownership. While the Bluewater mill was under construction, this company discovered and delineated several large ore bodies in both limestone and sandstone, and it soon became apparent that a second mill, for the treatment of sandstone ores, would be required in the district.

The Atchison, Topeka & Santa Fe Railway Co., upon proving sufficient ore reserves to justify a long-range operation, organized the Haystack Development Co. to develop and produce the ore bodies discovered on its lands. Many smaller companies and individuals also made important ore discoveries. Many of these properties were either in production or ready for production by early 1953.

The ore-buying depot at Bluewater originally was intended to handle limestone-type ores. As, however, the production potential of the district developed, and this depot began receiving sandstone ores for stockpile, a second buying depot was established, at Shiprock, in northwestern San Juan County. An agreement was negotiated by the A.E.C. with the Kerr-McGee Oil Co. to construct a mill at that location to process sandstone ore. This mill was completed in 1954 and presently is operating at capacity on ores produced in New Mexico and northeastern Arizona.

At about the time that the Kerr-McGee contract was negotiated, a second agreement was made by the A.E.C. with Anaconda, the latter contracting to double the capacity of its limestone-ore mill and to erect a mill of much larger capacity to treat the sandstone ores that were being produced and stockpiled in ever greater volume in the Grants-Bluewater area. The enlargement of the original mill has been completed and is in production. The mill to treat sandstone ores is expected to be operating by January 1956.

Many large mining and oil companies came into the state in 1953 and 1954, acquiring either operating properties or leases of large tracts of land on which to prospect. New companies were organized, and small holdings were consolidated. Fantastic deals were made for leases.

The Haystack Development Co., under the able "pioneer" management of T. O. Evans, discovered and developed several large ore bodies in both sandstone and limestone formations. The most important of the discoveries appears to be the Poison Canyon deposit in the Morrison sandstone. The mining operations of this company are carried on both as open-pit and underground production projects. This company is one

of the two largest producers in the district. Its ore reserves are reported to be very large.

The Anaconda company acquired, along with many other prospecting permits and leases, the rights to prospect the Laguna Indian lands. A discovery was made in the northeast quarter of the reservation that, after being drilled and developed, appears to be the most important uranium discovery in the entire United States to date. The ore occurs in two horizons of the Morrison sandstone. It is of excellent grade, and the proven ore reserves are very extensive. Other important ore bodies were found in the immediate area, and more recently an extension to the larger ore body has been discovered. The mine developed on the large deposit is called the Jack Pile, the new discovery being known as the Jack Pile Extension. The Jack Pile mine has been developed as an open-pit operation. Overburden to a depth of over 100 feet in places is being removed to expose the ore body for selective mining.

Other mines in the vicinity of the Jack Pile are the Hanosh, Wind Whip, and Woodrow. The Anaconda company, with John B. Knaebel as general manager, has carried on an aggressive campaign of prospecting not only in the Grants area, but in other sections of the State.

Airborne detection instruments are being used by many of the operators and prospectors in both planes and helicopters. Followup ground crews are, of course, necessary in aerial exploration work. Extensive drilling programs, for proving up surface indications and for prospecting blind ground considered promising, have been carried forward by all the operating companies and the more affluent prospectors. This work is being done with both core drills and rotary drills. When the rotary drill is used, the drilling is done dry, and the cuttings are recovered by injecting blasts of compressed air into the bottom of the hole at intervals to clear out the cuttings. The cuttings are caught and tested by Geiger or scintillator counter. Whichever type of drill is used, the holes usually are drilled large enough to permit a probe to be lowered to the bottom.

At present the more important ore producers, other than Haystack and Anaconda, are the Holly Uranium Corp., Amuranium Corp., South Peak Mining Co., Manol Mines, Glenn and Edith Mine, and Hanosh Mines, Inc. These are all operating in the northwest quarter of the State. Over 50 producing properties are registered with the State Mine Inspector.

Although the occurrence of uranium ores has been reported from 25 counties, more than 90 percent of all ore production to date has come from Valencia, McKinley, and San Juan Counties. Minor shipments of ore have been made from Socorro, Sierra, Grant, Sandoval, and Rio Arriba Counties. Small stockpiles of ore are being accumulated also at mines under development in several other counties. The exploration and development of promising prospects continue throughout the State on a. broad scale.

GEOLOGIC HORIZONS FAVORABLE TO DISCOVERY

Uranium ores have been found in New Mexico in 15 geologic formations, as indicated in the following table:

TABLE 20. GENERALIZED GEOLOGIC SECTIONS IN NEW MEXICO

AGE	NORTHWESTERN N.M.	NORTHEASTERN N.M.	CENTRAL N.M.
TERTIARY		Ogallala fm. †Santa Fe fm.	†Santa Fe fm. Datil volcanic
	†Wasatch fm. Nacimiento fm.	†Galisteo fm. Poison Canyon fm. Raton fm	†Baca fm.
CRETACEOUS	†Ojo Alamo ss. †Mesaverde gp. Mancos sh.	Vermejo fin. Pierre sh. Niobrara fm. Carlile sh. Greenhorn Is. Graneros sh.	Mesaverde gp. Mancos sh.
	*Dakota ss.	†Dakota ss. Purgatoire fm.	Dakota ss.
JURASSIC	*Morrison fin. *Summerville fin. *Todilto Is. Entrada ss.	Morrison fin. Wanakah fin. Entrada ss.	
TRIASSIC	Wingate ss. †Chinle fin. Shinarump congl.	†Chinle fm. Santa Rosa ss.	Chinle fin.
PERMIAN	San Andres fm. Glorieta ss. Yeso fm. †Cutler fm. †Abo fin.	San Andres fin. †Glorieta ss. Yeso fin. Abo fin. Sangre de Cristo fm	San Andres fm. Glorieta ss. Yeso fin. †Abo fin.
PENNSYLVANIAN	†Madera fin. Sandia fin.	Madera fm. Sandia fm.	Madera fin. Sandia fin.

* Principal producing zones.

† Small production or prospects.

URANIUM MINERALS

The minerals of principal importance in the current uranium-ore production in this State are tyuyamunite and metatyuyamunite, pitchblende and uranite, uranophane and beta-uranophane, and carnotite. Other minerals that are known to occur are torbernite and metatorbernite, autunite, uraniferous asphaltite, novacekite, and cuprosklodowskite. In addition, fergusonite, euxenite, and samarskite are found sparsely in many of the pegmatites of the northern part of the State.

ASSOCIATED MINERALS

The more commonly associated minerals are carbonaceous debris, bones of prehistoric animals and petrified wood, pyrite and marcasite in

sedimentary rocks, purple fluorite, copper sulfides and carbonates in shales and sandstones, hematite and limonite-stained zones in fractured sedimentary rocks, and bleached zones in sedimentary rocks. Structural settings favorable for uranium mineral deposition are not limited or predictable. The ore has been found in so many geologic phases and attitudes that it would be unwise to deny the possibility of its occurrence in any structure. However, some of the structural features that appear favorable are areas marginal to major faulting; sedimentary channels and facies in channel changes, especially where carbonaceous debris is evident; rolls and downwarped zones in sediments; faults in both sedimentary and igneous rocks; major and minor joints; shear zones that carry other mineralization; veins; dikes; and sills (pegmatites).

ATOMIC ENERGY COMMISSION

The Atomic Energy Commission established a second field office in New Mexico in 1953. Its present address is 301 Washington SE., Albuquerque. This office has general supervision over the entire State, except the northwest quarter. It is staffed to give assistance to prospectors in evaluating mineral discoveries. It activates and supervises limited drilling programs on some of the more promising deposits. It also carries on a flying program over areas thought to be favorable for ore deposits and releases anomaly maps showing its findings.

REVIEW BY COUNTIES

BERNALILLO COUNTY

The occurrence of uranium minerals associated with carbonaceous material in the Pennsylvanian and Madera limestone has been reported from sec. 23, T. 10 N., R. 5 E. Uranium also occurs with copper minerals in Abo sandstone and shales, sec. 2, T. 9 N., R. 5 E.

There has been no production of ore from either of these occurrences. A core-drilling program on the Abo showing is planned.

CATRON COUNTY

Discoveries of uranium-bearing minerals have been reported from the Apache National Forest, the Reserve area, and the north portion of the Gila National Forest. Specimens of materials from these areas have been brought to the Bureau, but the bearers were unwilling to provide positive identification of the location of the discoveries. All specimens showed some radioactivity. Some might be classed possibly as low-grade ore. The Apache and Reserve specimens were igneous rocks; the Gila specimen was sandstone.

COLFAX COUNTY

Two occurrences of radioactive material have been reported. No samples or specimens of the material have been received at the Bureau.

One occurrence, about 30 miles southeast of Raton, is being drilled by a group from Houston, Texas.

DONA ANA COUNTY

Uranium minerals occur with the dark-purple fluorite in the Bishop's Cap area. No deposits of commercial importance have been developed.

Radioactive minerals also occur in some of the old hot-springs residue near lava flows and intrusives, east of Hatch and Mesquite. In some areas the waters of presently active hot springs carry trace amounts of radioactive materials.

EDDY COUNTY

The Rocky Arroyo area, about 40 miles northwest of Carlsbad, contains several showings of uranium-bearing minerals. The material is a black, asphaltic mineral occurring in fracture seams and as blebs and specks in limestone. Ore of commercial grade and volume has not been developed. Over 400 mineral claims have been staked in the area.

GRANT COUNTY

The White Signal district has been the locale for most of the uranium activity in Grant County. Extensive prospecting and development have been carried out in an attempt to develop a commercial ore body in or adjacent to the old mine workings. The Atriminas Mining Co. has shipped two carloads of ore to the mill at Bluewater. The grade of the ore has not been made public. Many new claims have been staked in the district.

Uranium mineralization has been found at various places in the Burro Mountains. The minerals are associated with purple fluorite at the Langford, Hines, and Purple Rock mines. Minor amounts of autunite and uranophane are present at the Hines and Langford properties. Extensive showings of low-grade uranium mineralization have been found in the Little Burro Mountains.

Uranium and thorium mineralization has been found associated with pegmatite dikes of Precambrian age in the Gold Hill district. Euxenite, allanite, and samarskite have been noted.

In the Black Hawk district a uranium mineral, possibly pitchblende, has been reported as occurring with the nickel-cobalt-silver mineralization in both the Black Hawk and the Alhambra mines.

GUADALUPE COUNTY

Uranium mineralization has been reported from an area northeast of Santa Rosa; also from the vicinity of the asphalt-sand deposits.

HARDING COUNTY

Extensive prospecting is being carried out in the area just west of Ute Creek. Some promising showings have been found, but most of the

anomalies mapped have been near old bone yards. Radioactive skeletons of dinosaurs have been found.

HIDALGO COUNTY

Uranium-bearing deposits are being prospected and developed along the Mexican border, just east of the Big Hatchet Mountains. The possibilities of these deposits have not been determined.

LEA COUNTY

A showing of radioactive minerals has been reported from the Cap Rock country, southwest of Lovington, and a discovery has been made in the San Simon sink area, southwest of Eunice. No production has come from the county.

LINCOLN COUNTY

Uranium and thorium minerals have been found in the Capitan Mountains, north of Capitan. Also, a showing has been noted in a highly altered granite breccia northeast of Capitan. Small amounts of uranium ore occur along the edges of some of the iron ore bodies, north of Carrizozo.

None of the deposits has proven of commercial grade or volume.

LUNA COUNTY

Radioactive fluorspar occurs in the Cooks Peak area, and similar occurrences have been reported south of the Little Florida Mountains. No commercial deposits have been developed.

MCKINLEY COUNTY

The first uranium-ore discovery in the State was made at Haystack Mountain, in this county. The discovery was of tremendous interest, because it marked the first known occurrence of uranium minerals in limestone in the Colorado Plateau area. It also ushered in the wildest era of prospecting New Mexico has ever known. Many hundreds of mineral locations were staked on the public domain, and State and Indian lands were leased wherever conditions were thought favorable for finding uranium ores.

Numerous ore discoveries have been made, and at this time there are 15 producing mines and a hundred or more promising prospects in the county. The most important producers are the Haystack and Poison Canyon mines of the Haystack Development Co. Other good producers are the Glenn and Edith, Hanosh, Inc., Manol, and South Peak mines, the Amuranium Corp., and the Holly Uranium Corp.

Most of the ore from the county goes to the mill and stockpile at Bluewater.

MORA COUNTY

Uranium ore has been found with the copper mineral chalcocite in Permian shales and arkose in a discontinuous belt 4-5 miles in length

along Coyote Creek, near Guadalupita. Discoveries a few miles to the south and west also have been reported. Other "hotspots" are reported from the pegmatite-dike area in the western part of the county. No production has come from the county to date.

OTERO COUNTY

Minor amounts of uranium minerals have been found in the old copper workings near Orogrande. Prospecting in the county is limited because of the very large land areas included in the military reservations.

QUAY COUNTY

Uranium ore has been found at several localities in the vicinity of Tucumcari and southwest of San Jon. The mineral occurs in the Chinle sandstone and conglomerates. No ore bodies of importance have been developed to date. The more interesting finds are in T. 9 N., R. 33 E.; T. 10 N., R. 33 E.; and T. 11 N., R. 32 E. Areas of high anomaly are indicated in T. 10 N., R. 29 E.; T. 11 N., R. 30 E.; and T. 13 N., R. 31 E.

Many bone yards of prehistoric animals are found in the general area around Tucumcari. Most of these are highly radioactive, as are some plant fossils.

RIO ARRIBA COUNTY

Prospectors have been active in Rio Arriba County, and some promising locations have been made. Only small amounts of ore have been produced and shipped to Bluewater for testing.

Greatest activity has been in the Abiquiu-Youngsville-Coyote area, and south to Sandoval County. Many hundreds of claims have been staked, and all available State and private lands have been leased for prospecting.

Much drilling, tunnel, and open-pit work is being done in an effort to prove up commercial ore bodies. The ores in this area have been found in carbonaceous shales, sandstone, and siltstones.

The Petaca mining district, located in the easternmost part of the county, has long been known for its pegmatite dikes, which sometimes carry small amounts of the radioactive minerals pitchblende, uraninite, and monazite. The uranium minerals are so scattered, and occur in such small amounts, that the district is not believed to have favorable uranium possibilities.

SANDOVAL COUNTY

Uranium mineralization was reported from the Bland district about 1920, marking one of the earliest discoveries in the State. No particular attention was given to this discovery at that time, nor has much interest been shown in the district recently.

The Nacimiento Mountains region and the shale beds and sandstone formations around La Ventana, Cuba, and Cabezon have been prospected very actively. A number of good ore showings have been found,

and development work is under way to prove up commercial ore bodies. Ore shipments have been made from one or two properties. Increased production is expected from the county in the near future.

SAN JUAN COUNTY

The western half of San Juan County is occupied by the Navajo Indian Reservation. Prospectors have leased large tracts of land from the Tribal Council, and numerous ore discoveries have been made. Eight mines are producing ore, and a large number of discoveries are in the prospect-development stage.

An ore-buying depot was set up at Shiprock by the A. E. C. in 1952 to receive ore from the Four Corners area (see p 155). On the basis of ore received and the ore-production potential in the area, the A. E. C. in 1953 contracted with the Kerr-McGee Oil Co. to construct a mill at Shiprock to treat the stockpiled ores and ore produced from its own mines, and to continue the ore-purchase program for San Juan County and northeastern Arizona. This mill presently is operating at capacity.

Ore discoveries have been made in areas other than the reservation, and prospecting continues at a rapid pace. The more important discoveries have been made in the Morrison, Summerville, Dakota, Mesaverde, and Chinle formations.

SAN MIGUEL COUNTY

Carnotite-type uranium mineralization of ore grade has been found in the Sabinosa area in sandstone, shale, and conglomerate lenses in the Chinle formation. Much activity is evident in this area and in the Canyon Largo district, a short distance to the southwest. Although no shipments of ore have been reported from this region as yet, appreciable stockpiling of ore from development work is reported. The country is cut by the Mora and Canadian Rivers and by the Canyon Largo Arroyo, which have developed deep canyons, exposing thick sections of the flat-lying sedimentary formations. Some discoveries have been made in the canyon walls.

Radioactivity has been noted in a highly altered granite zone in Gallinas River Canyon, about 14 miles northwest of Las Vegas. Many of the pegmatite dikes near the heads of the Gallinas and Sapello Rivers also show some radioactivity.

SANTA FE COUNTY

Uranium minerals have been found at two places on the San Cristobal Grant, a few miles southeast of the village of Galisteo. Carnotite-type mineralization occurs in a limestone conglomerate and in sandstone of the Chinle formation. No attempt has been made to develop the deposits.

G. T. Griswold reported finding low-grade uranium mineralization on the Ortiz Grant, 30 miles southwest of Santa Fe. It is associated with carbonaceous lenses in the Tertiary Galisteo formation.

Two occurrences have been found in the La Bajada Hill area. One, containing both uranium and thorium, was found in sandstone and shale. The other discovery was in a Tertiary andesitic sill. Some autunite is present. Small deposits, some of ore grade, have been reported from the so-called "badlands" southeast of Santa Cruz.

No ore production has been reported from the county to date.

SIERRA COUNTY

Highly radioactive materials have been found near the south end of the Caballo Mountains, southeast of the Caballo reservoir. Uranium and, in places, thorium mineralization occurs in interstitial chlorite and in seams and fractures in a highly altered granite mass. Some fluorspar and minor amounts of galena are present. Minor uranium mineralization occurs at many other scattered points along the Caballo Mountains.

An occurrence of pitchblende-type mineralization has been found in minor amounts along a thin shear zone in Precambrian schists at the southern limits of Truth or Consequences.

Uranium mineralization has been discovered at the Terry Brothers property (also known as the Hanosh prospect), near Monticello. Mineralization occurs in dark-purple fluorite and includes some uranophane.

Other uranium occurrences are reported from the Winston, Hermosa, and Cuchillo areas. These showings are mostly in veins of fluorite and in brecciated silicified dikes.

No ore shipments have been reported.

SOCORRO COUNTY

Uranium ore has been found in several widely scattered areas in Socorro County. One of the earliest discoveries was made on the Hook ranch, about 18 miles northwest of Magdalena. The mineralization here is spotty over a large area. It occurs in conglomerate, shale, and sandstone of the Baca formation. A large number of claims have been staked in the vicinity of the discovery, and some leases have been made covering private lands. The original discovery was made on land owned by the Atchison, Topeka & Santa Fe Railway Co. No production has come from the district to date.

A discovery was made on the northeast flank of Ladron Peak during the summer of 1954. The ore occurs here in material in a large fault zone in a granite mass. About 70 tons of ore have been produced from open-pit operations at the discovery site. The discovery was made on public domain under lease to Charles Jeeter, and the mine is known as the Jeeter mine. Several hundred claims have been located in the area, and much drilling and open-pit prospecting are being done. Low-grade uranium ore was found in a zone of dikes just west of Lemitar,

some 12 miles south of the Jeeter mine, but drilling and pit exploratory work have not disclosed ore of commercial grade.

Several occurrences have been reported from the La Joya (Servilleta) Grant, owned by Gen. Thomas Campbell, but little information regarding the deposits is available.

A more recent discovery (April 1955) was made by the Holly Uranium Co. near the Del Curto ranch, about 10 miles east of Socorro. This deposit is being developed. It occurs in brecciated limestone.

TAOS COUNTY

Several occurrences of uranium in Precambrian pegmatite dikes have been reported from the Red River area and east of Costilla. No commercial ore bodies have been found.

TORRANCE COUNTY

Small seams of carnotite-type ore occur in thin sandy shale and conglomerate zones of copper-bearing Permian sandstones in the area north of Scholle. Large, discontinuous zones of low uranium content extend along Priest Canyon in a belt more than 1 mile in length.

No ore production has been reported from the county.

VALENCIA COUNTY

Uranium ore was found in Valencia County within a few months after the nearby Haystack Mountain discovery in McKinley County. Twelve operators are producing ore from about 20 properties in the county at this time. The jack Pile and Jack Pile Extension mines of the Anaconda Co. are the largest producers. Located on the Laguna Indian Reservation, these mines are operated as open-pit projects and are reported to contain very large ore reserves. The ore occurs in the Morrison sandstone.

Other producers in the county include Calumet and Hecla, Inc., the Continental Divide Uranium Co., the Colmar Corp., the All States Uranium Corp., the Amuranium Corp., and the Permian Basin Uranium Corp. The Laguna and Acoma Indian Reservations are totally within the county, and a small portion of the Zuni Reservation extends into the northwest corner. All these lands have been leased for prospecting, as have all State-owned lands and much of the privately owned land. Prospecting has been carried on over most of the county, and many promising discoveries have been made. Most of the ore has been found in sandstone.

Anaconda's uranium-processing mill is located at Bluewater. A spur from the main line of the Atchison, Topeka & Santa Fe Railway serves the plant. A paved road connects the mill with U. S. Highway 66.

SUMMARY

In spite of a late start, as compared with Colorado and Utah, the production of uranium ores in New Mexico has forged ahead at a tremendous pace and undoubtedly will equal or surpass that from other states at an early date. Known ore reserves are very large, and new discoveries continue to be made. Production statistics and ore-reserve estimates are restricted information. It is permissible, however, to state that the value of the ore produced during the last half of 1953 and the first half of 1954 exceeded $3 million.

Prospecting for Mineral Deposits and Locating Mining Claims

Many letters are received annually by the State Bureau of Mines and Mineral Resources requesting information regarding prospecting for minerals and the procedure for locating mining claims.

The mining laws of New Mexico are given in Bulletin 16 of the State Bureau of Mines and Mineral Resources, by C. H. Fowler and S. B. Talmage. Entitled "Mining, Oil, and Mineral Laws of New Mexico," this bulletin was released in 1941 and is a compilation of all the mineral laws of the State in effect at that time. Few changes in the mining laws have been made since the publication of this summary, but the oil and gas regulations have been revised materially. The State laws and the Federal laws do not coincide entirely, and it is suggested that the requirements of both be studied. Both laws prevail on the public domain.

The State Land Office has certain regulations with which prospectors operating on State lands must comply. Copies of these can be obtained from the Commissioner of Public Lands, at Santa Fe.

Answers to the most common questions regarding methods of prospecting, the location of mineral claims, and allied subjects are provided in Information Circular 7535, issued by the U. S. Bureau of Mines. This circular has been reprinted by the State Bureau of Mines and Mineral Resources and can be obtained free of charge upon application to the Bureau's office in Socorro.

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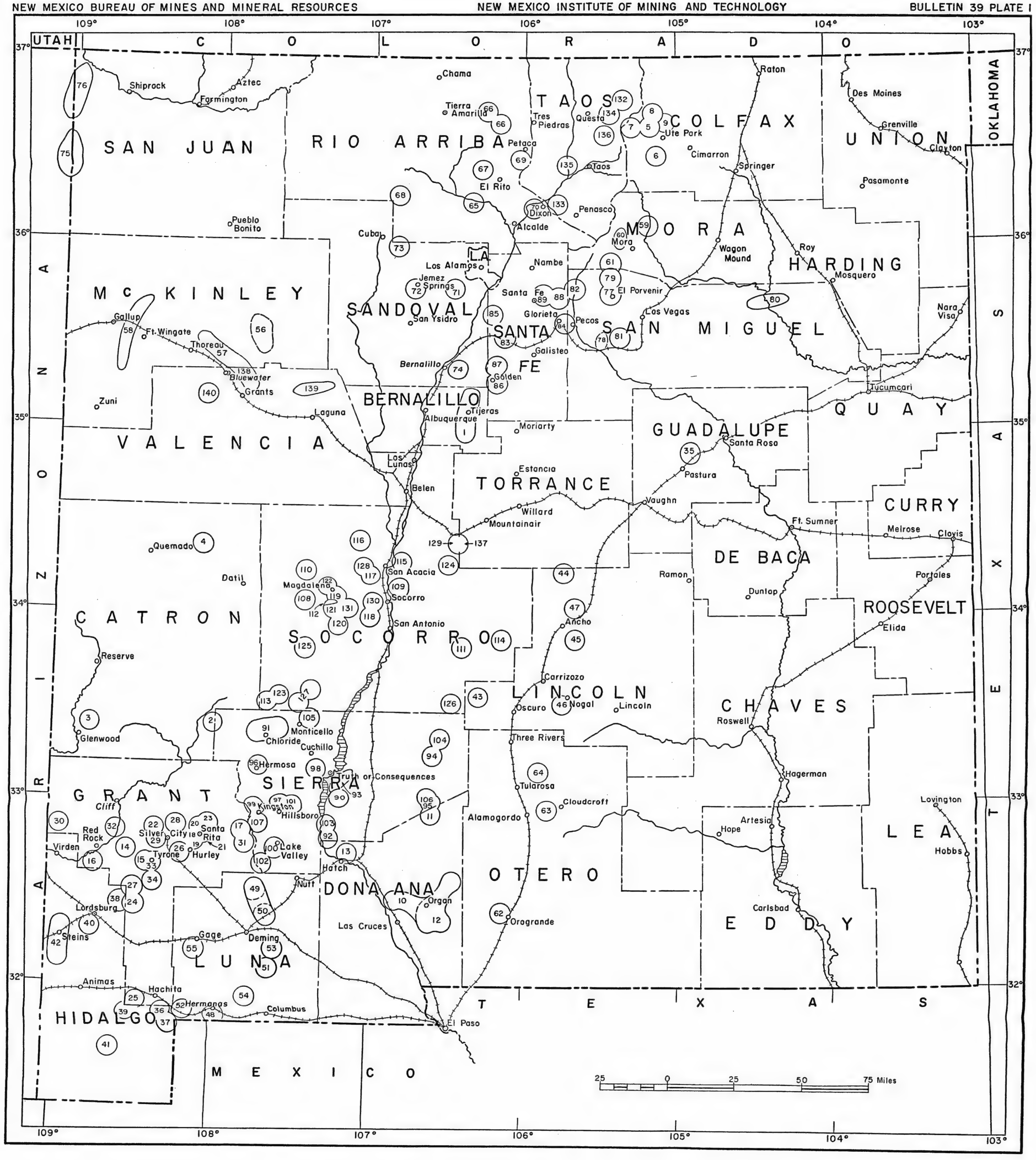


Metal Mining Districts and Subdistricts
New Mexico - 1955

BERNALILLO COUNTY

1. Tijeras Canyon — Lead (gold, silver)

CATRON COUNTY

2. Black Range (Taylor Creek) Tin — Tin
3. Mogollon (Cooney) — Gold, silver (copper, lead)
4. McPhaul Ranch — Uranium

COLFAX COUNTY

5. Baldy (Ute Creek) — Gold, silver (copper, lead, tungsten)
6. Cimarroncito — Gold (copper, silver)
7. Elizabethtown (Moreno) — Gold
8. Ponil — Gold
9. Willow Creek — Gold

DONA ANA COUNTY

10. Black Mountain-Gold Camp — Lead, copper (gold, silver, zinc, bismuth)
11. Hembrillo-San Andrecito — Copper
12. Organ (Modoc, Texas) — Lead, copper (gold, silver, zinc, molybdenum, bismuth)
13. Rincon Manganese — Manganese

GRANT COUNTY

14. Black Hawk (Alhambra, Bullard's Peak) — Silver (nickel, cobalt)
15. Burro Mountains (Tyrone, *Cow Springs*) — *Copper (gold, silver)*
16. Cap Rock Mountain Manganese — Manganese
17. Carpenter — *Lead-zinc*
    Central area:
18. Bayard — Zinc, lead, copper
19. Central — Zinc, lead, copper, silver
20. Hanover-Fierro — Zinc, lead, copper, silver, manganese, iron
21. Santa Rita — Copper, molybdenum
22. Fleming (Bear Mountain) — Silver
23. Georgetown (Mimbres) — Silver
24. Gold Hill — Gold, silver
25. Hachita (Eureka): also see Hidalgo Co. — Gold, silver (copper)
26. Lone Mountain — Silver, lead
27. Malone — Gold, silver
28. Pinos Altos — Gold, silver, copper, lead, zinc
29. Silver City: includes — Manganese, iron, silver
    Boston Hill
    Chloride Flat
30. Steeple Rock — Gold, silver
31. Swartz — Zinc, lead, gold, silver
32. Telegraph — Silver
33. Tyrone — Copper, gold, silver
34. White Signal — (Gold, silver, copper, lead, zinc, uranium)

GUADALUPE COUNTY

35. Pastura (Pintada) — Copper

HIDALGO COUNTY

36. Apache No. 2 (Anderson) — Copper (gold, silver, bismuth, tungsten)
37. Fremont — Copper, lead, zinc (gold, silver)
38. Gold Hill — Gold
39. Hachita (Eureka, Sylvanite) — Copper, lead, zinc (gold, silver, antimony-arsenic, tungsten, tellurium)
40. Lordsburg (Pyramid,, Virginia) — Copper, gold, silver, lead
41. Red Hill (Gillespie) — *Lead, gold, silver, copper*
42. Steins Pass-San Simon — *Silver, gold*

LINCOLN COUNTY

43. Estey (Oscuro) — Copper
44. Gallinas Mountains ((Red Cloud) — Silver, lead, copper (iron, rare earths)
45. Jicarilla — Gold (silver, copper)
46. Nogal — Gold (copper, lead, zinc)
47. White Oaks — Gold (tungsten, iron, uranium)

LUNA COUNTY

48. Carrizalillo Hills — Copper, gold
49. Cooks Peak — Lead, zinc (copper, gold, silver, manganese)
50. Cooks Range Manganese — Manganese
51. Florida Mountains — Lead, zinc, silver, manganese
52. Fremont — Copper, lead, zinc
53. Little Florida Mountains (Manganese Valley) — Manganese
54. Tres Hermanas — Gold, silver, lead, zinc
55. Victorio (Gage) — Silver, lead, gold, copper, zinc, tungsten, iron

McKINLEY COUNTY

56. Ambrosia Lake — Uranium
57. Grants (extends into Valencia County) — Uranium, vanadium
58. Hogback (Ft. Wingate) — Uranium, vanadium

MORA COUNTY

59. Coyote Creek — Copper, silver, uranium
60. Rio la Casa — Gold
61. Upper Rociada — Lead, zinc, copper, gold, silver

OTERO COUNTY

62. Orogrande (*Jarilla*, Silver Hill, Brice) — Copper, gold, silver, lead, iron, tuagsten
63. Sacramento (*High Rolls*) — Copper, lead
64. Tularosa (Bent) — Copper, gold, silver

RIO ARRIBA COUNTY

65. Abiquiu — Copper, uranium
66. Bromide-Hopewell (Headstone) — Copper, gold, silver, lead, zinc
67. El Rito Placer — Gold
68. Gallina (Coyote, Yougsville) — *Copper, lead, silver, uranium*
69. Petaca — Beryllium, columbium, fluorine, rare earths
70. *Rinconada (West Pichuris)* — Tungsten

SANDOVAL COUNTY

71. Cochiti (Bland) — Gold, silver, uranium
72. Jemez Springs — Gold, silver, copper
73. Nacimiento Mountains (Cuba) — Uranium, copper
74. Placitas — Gold, silver, copper, lead

SAN JUAN COUNTY

75. Chuska — Uranium, vanadium
76. Shiprock — Uranium, vanadium

SAN MIGUEL COUNTY

77. El Porvenir (Hermit Mountain) — Molybdenum, bismuth, tungsten
78. Ribera — Beryllium, rare earths
79. Rociada — Gold, silver, copper, lead, zinc, beryllium, tantalum, lithium
80. Sabinosa — Uranium
81. Tecolote — Copper
82. Willow Creek (Pecos, Cooper) — Zinc, lead, gold, silver, copper

SANTA FE COUNTY

83. Cerrillos — Silver, lead, zinc
84. Glorieta — Copper, iron
85. La Bajada — Copper, silver, uranium
86. New Placers (San Pedro) — Gold, silver, copper, lead, zinc
87. Old Placers (Ortiz, Dolores) — Gold, copper, tungsten
88. Santa Fe — (Gold, silver, copper, lead, zinc)
89. Santa Fe Manganese — Manganese

SIERRA COUNTY

90. Caballo Mountains — Copper, lead (vanadium, thorium, uranium)
91. Chloride (Apache, Black Range, Cuchillo Negro) — Gold, silver, copper, lead, vanadium
92. Derry Manganese — Manganese
93. Fra *Cristobal* Range — Zinc, copper, manganese, lead
94. *Goodfortune*: see Socorro Co. — Copper (silver)
95. Grandview Canyon: see Socorro Co. — Copper
96. Hermosa (Palomas) — *Silver*, copper, lead
97. Hillsboro (Las Animas) — Gold, copper, manganese
98. Hot Springs (Mud Springs) — Silver, copper, manganese
99. Kingston (Black Range) — Silver, gold, copper, lead, manganese
100. Lake Valley — Manganese, silver, lead
101. Las Animas (Gold Dust) Placer — Gold
102. Macho — Lead, silver
103. Pittsburg (Shandon) Placer — Gold
104. Salinas Peak: see Socorro Co. — Copper, lead
105. San Mateo Mountains — Gold, silver, copper, lead
106. Sulphur Canyon: see Socorro Co. — Copper
107. Tierra Blanca (Bromide) — Silver, gold, copper, lead

SOCORRO COUNTY

108. Cat Mountain — Gold
109. Chupadera — Copper, lead
110. Council Rock — Lead, silver
111. Hansonburg (Carthage) — Lead, copper
112. Hop Canyon — Gold
113. Iron Mountain — Iron, tungsten, beryllium
114. Jones Camp — Iron
115. Joyita Hills (Canyoncito) — Lead
116. Ladron Mountains — Lead, zinc, manganese, uranium
117. Lemitar Mountains — Zinc, lead, uranium
118. Luis Lopez-Socorro Manganese — Manganese
119. Magdalena — Zinc, lead, copper, gold, silver, manganese, vanadium
120. Magdalena Mountains Manganese — Manganese, copper, lead, zinc, gold, silver
121. Mill Canyon — Copper, gold
122. North Magdalena — Copper
123. Ojo Caliente — Copper, lead
124. Rayo — Copper
125. Rosedale — Gold
    San Andres Mountains::
    Goodfortune: see Sierra Co.
    Grandview Canyon: see *Sierra Co.*
126. Mockingbird Gap — Copper, lead, zinc
    Salinas Peak: see *Sierra* Co.
    Sulphur Canyon: see : Sierra Co.
127. San Jose (Nogal, San Mateo) — Gold, silver
128. San Lorenzo (San Acacisa) — Copper, uranium
129. Scholle — Copper, silver, uranium
130. Socorro Peak — Silver, lead
131. Water Canyon (Silver Mountain) — Copper, lead, zinc, gold, silver, manganese

TAOS COUNTY

132. Anchor (La Belle) — Gold
133. Picuris (Copper Hill) — Copper, gold, silver, beryllium, lithium, tantalum, tungsten
134. Red River — Molybdenum, silver, copper, lead
135. Rio Grande Placer — Gold
136. Rio Hondo (Twining) — Copper, lead, zinc, gold

TORRANCE COUNTY

137. Scholle — Copper, uranium

VALENCIA COUNTY

138. Grants (extends into McKinley County) — Uranium, vanadium
139. Laguna — Uranium, vanadium
140. Zuni Mountains (Copper Hill, Copperton, Montezuma) — Copper, gold, silver, uranium

GOLD

1,000 Fine Ounces
100,000 Dollars
Weight
Value
100,000 Dollars
1,000 Fine Ounces

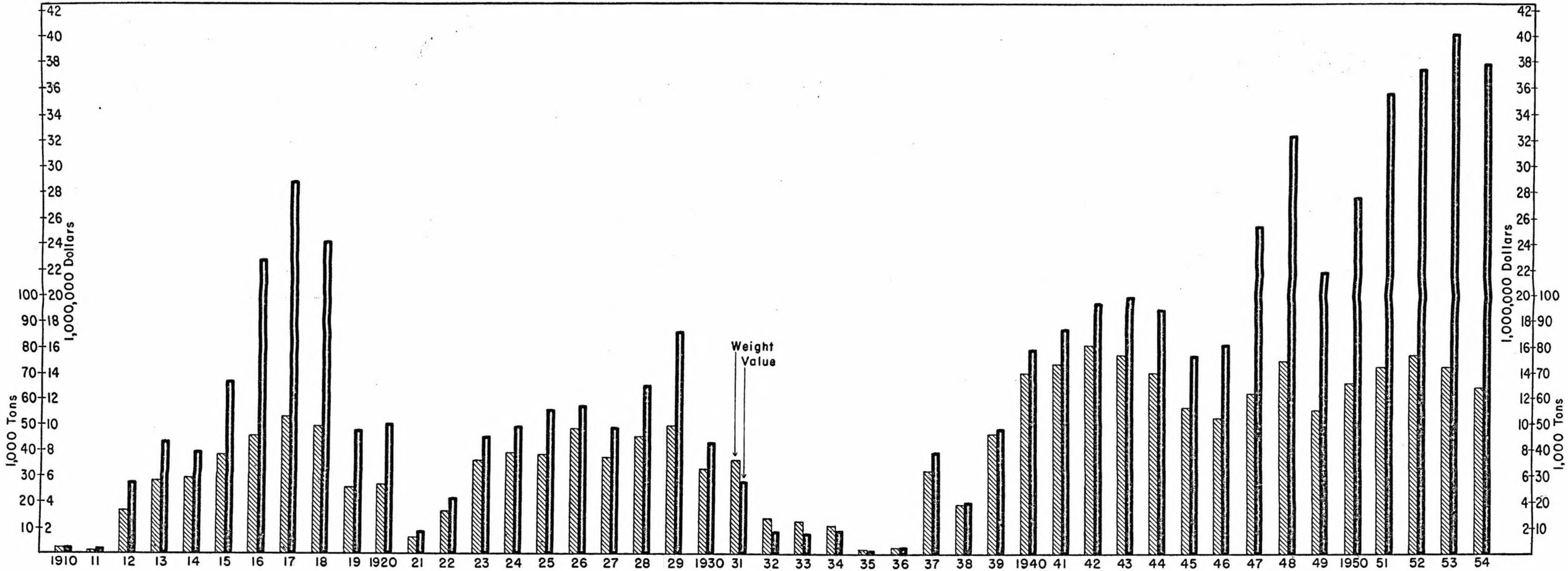
1910 11 12 13 14 15 16 17 18 19 1920 21 22 23 24 25 26 27 28 29 1930 31 32 33 34 35 36 37 38 39 1940 41 42 43 44 45 46 47 48 49 1950 51 52 53 54

SILVER

100,000 Fine Ounces
100,000 Dollars
Weight
Value
100,000 Dollars
100,000 Fine Ounces

1910 11 12 13 14 15 16 17 18 19 1920 21 22 23 24 25 26 27 28 29 1930 31 32 33 34 35 36 37 38 39 1940 41 42 43 44 45 46 47 48 49 1950 51 52 53 54

PRODUCTION OF GOLD AND SILVER IN NEW MEXICO, 1910-1954



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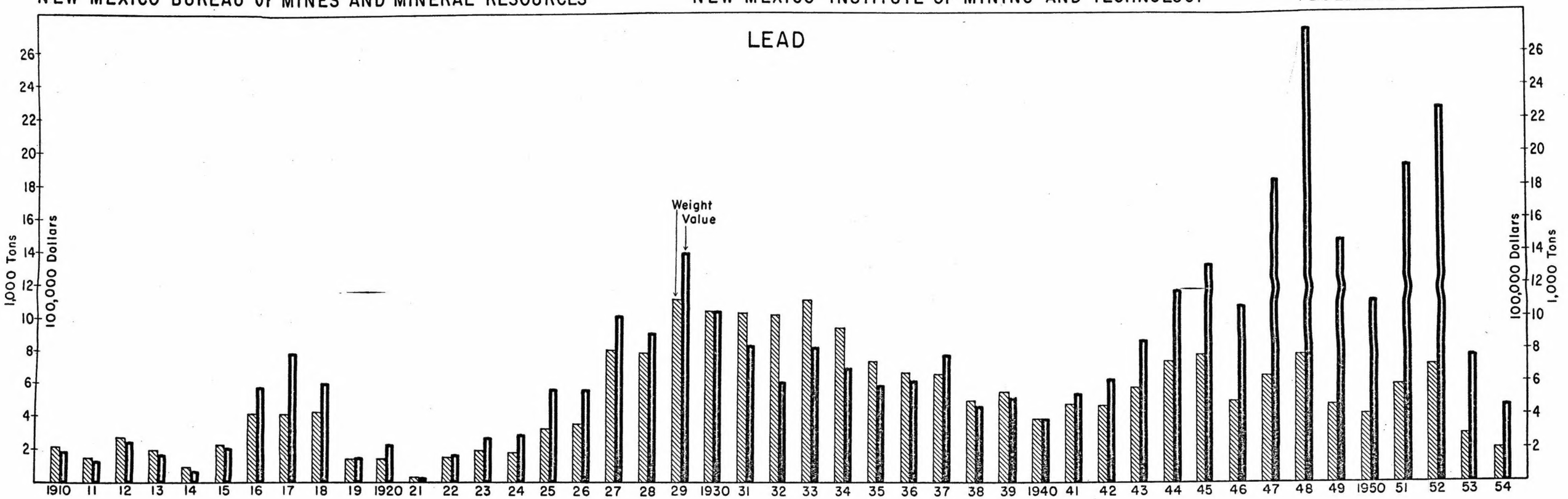
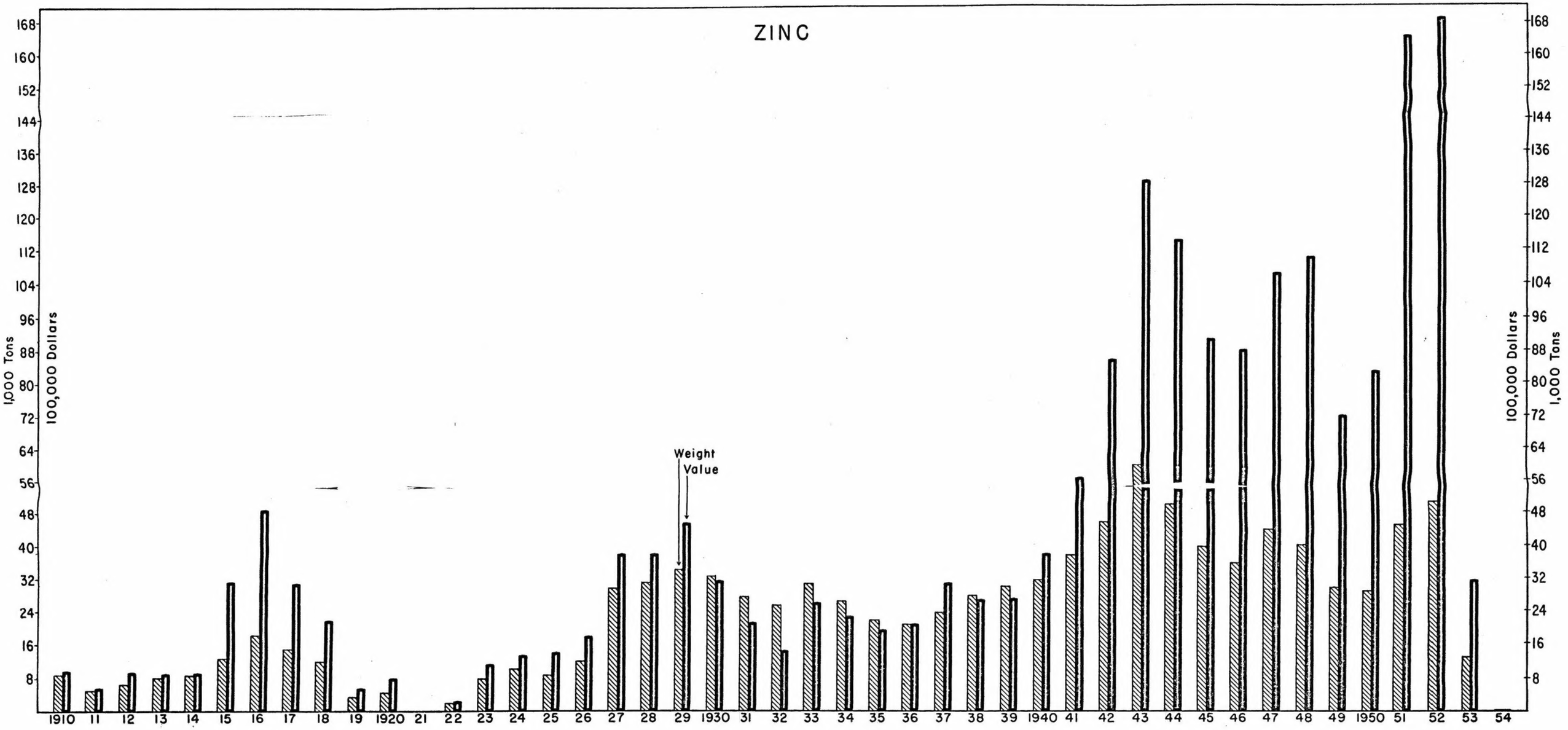
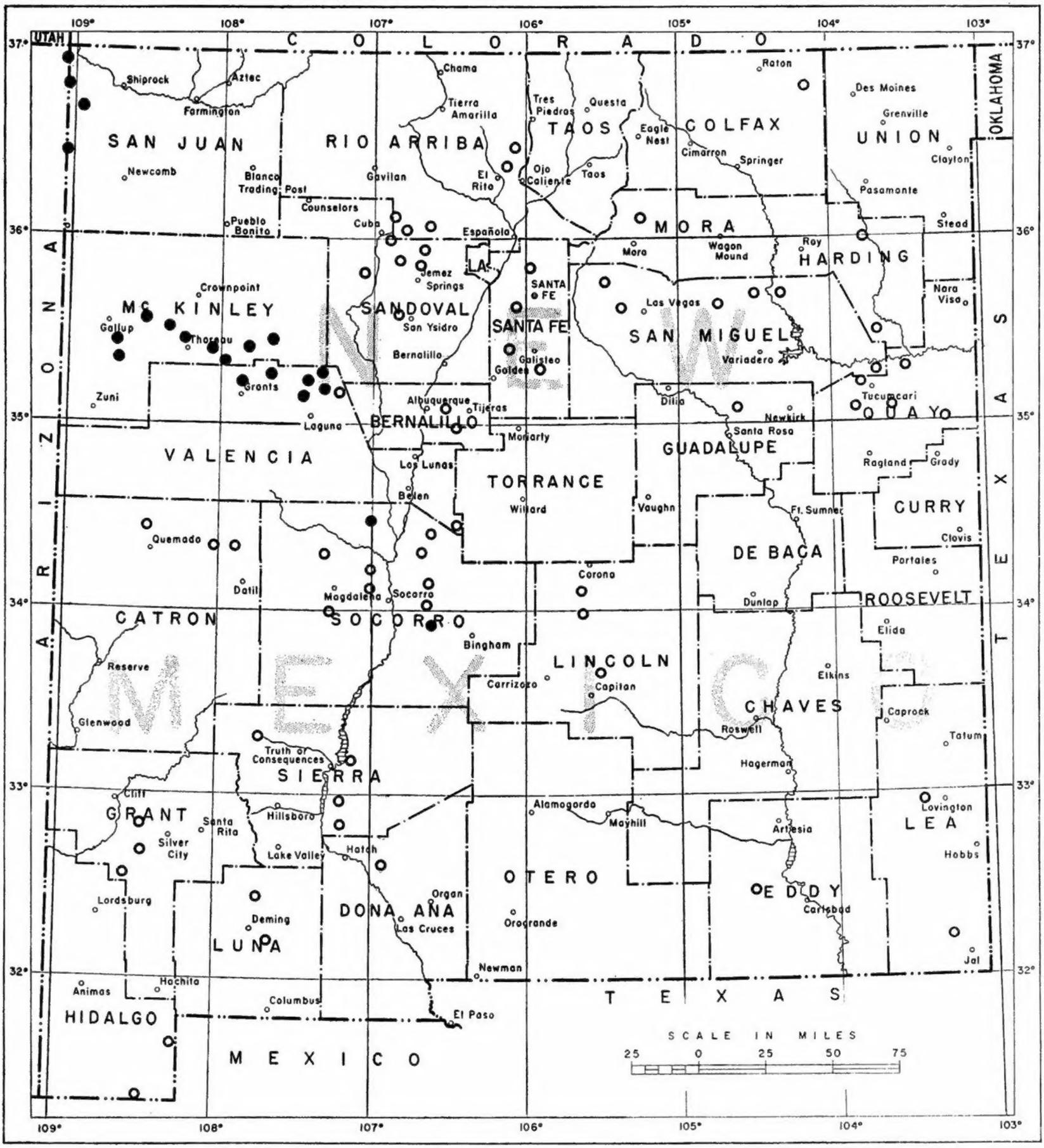




PRODUCTION OF LEAD AND ZINC IN NEW MEXICO, 1910-1954



URANIUM IN NEW MEXICO, JANUARY 1955

● MINES ○ PROSPECTS